GUIDE
FOR THE PREPARATION OF
TECHNICAL DEVELOPMENT PLANS

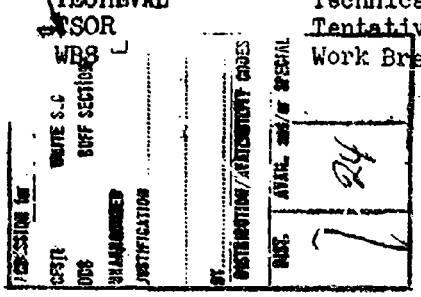
PUBLISHED BY THE DIRECTION OF
THE CHIEF OF NAVAL MATERIAL

JULY 1965

NAVMAT P3910

ABBREVIATIONS

ADO	Advanced Development Objective
ASN(R&D)	Assistant Secretary of the Navy (Research and Development)
BUPERS	Bureau of Naval Personnel
BUSHIPS	Bureau of Ships
BUWEPS	Bureau of Naval Weapons
CD	Contract Definition
CF	Concept Formulation
CNM	Chief of Naval Material
CNO	Chief of Naval Operations
CNP	Chief of Naval Personnel
COMOPTEVFOR	Commander, Operational Test and Evaluation Force
COSAL	Coordinated Ships Allowance List
DCNO(D)	Deputy Chief of Naval Operations (Development) (Op-07)
DDR&E	Director of Defense Research and Engineering
ECM	Electronic Countermeasures
ECCM	Electronic Counter Countermeasures
EDR	Exploratory Development Requirements
FYFS&FP	Five Year Force Structure and Financial Program
GOR	General Operational Requirement
MPE	Monthly Progress Evaluation
MTBF	Mean Time Between Failures
MTTR	Mean Time To Repair
NAVMAT	Office of the Chief of Naval Material
NEC	Navy Enlisted Classification
NMSE	Naval Material Support Establishment
NOBC	Navy Officers Billet Code
NRR	Navy Research Requirements
NTDS	Naval Tactical Data System
OMN	Operation and Maintenance, Navy
OPN	Other Procurement, Navy
OPNAV	Office of the Chief of Naval Operations
OSD	Office of the Secretary of Defense
PCP	Program Change Proposal
PDA	Principal Development Activity
PDP	Project Definition Phase
PMP	Project Master Plan
PERT	Performance Evaluation Review Technique
PTA	Proposed Technical Approach
RDT&E	Research, Development, Test and Evaluation
RFI	Radio Frequency Interference
SCN	Shipbuilding and Conversion, Navy
SOR	Specific Operational Requirement
TDP	Technical Development Plan
TECHEVAL	Technical Evaluation
TSOR	Tentative Specific Operational Requirement
WBS	Work Breakdown Structure



GUIDE
FOR THE PREPARATION OF
TECHNICAL DEVELOPMENT PLANS

PUBLISHED BY THE DIRECTION OF
THE CHIEF OF NAVAL MATERIAL

JULY 1965

SN 0518-391-0000

NAVMAT P3910

TABLE OF CONTENTS

*Principal Development Activities should insert a copy of the current edition of OPNAVINST 3910.4 series as Appendix A to this guide.

LIST OF ILLUSTRATIONS

For sale by Superintendent of Documents. Price $1.75

RECORD OF CHANGES			
CHANGE NO.	DATE OF CHANGE	DATE ENTERED	BY WHOM ENTERED

INTRODUCTION

The purpose of this Guide is to *assist* Principal Development Activities (PDAs) within the Naval Material Support Establishment (NMSE) in the preparation of Technical Development Plans (TDPs) by providing *guidelines* for the preparation of these plans. As such, this document is intended to present an outline of the needs of the CNM, CNO, and the OSD to properly evaluate the technical, managerial, financial, and personnel plans for the development, and all available information on procurement and production. While compliance with this Guide is not mandatory, the Office of the Chief of Naval Material (NAVMAT) will use it as a basis for reviewing specific TDPs.

In preparing a document of this type, the inclusion of all the specifics related to the various developments that fall under the auspices of the NMSE would result in an unwieldy and confusing document. Therefore, this Guide was written around a particular type of development, but it is felt that the general guidelines are applicable to many other types of developments. Wherever specific examples are given, they are not intended to be used as the only approach or, necessarily, as the recommended approach.

Adherence to the general guidelines contained in this Guide will provide desired uniformity among TDPs which will facilitate review by all reviewing echelons.

In addition, it is anticipated that a TDP will result which:

(1) analyzes and assesses the operational requirement;
(2) establishes the detailed nature of a development particularly in regard to the specification of technical design characteristics which if met permits a quantitative judgment of the success of the project;
(3) acts to provide a current document for coordinating the activities and plans for several groups;
(4) states the management plan needed to carry out the development program along with the required financial and manpower resources;
(5) serves as the basic decision making document for all levels of management throughout the development;
(6) once approved, constitutes the authority to commence or continue the development and defines the technical, managerial, financial and personnel criteria accepted by CNM;
(7) sets forth, at the earliest practicable date, information on production quantities, production schedule, documentation, possibility of competitive buys, contractors, contract type, and contract value.

Each section of this Guide is organized in accord with the general instructions for TDP preparation as described in OPNAVINST 3910.4 series. In addition, instructions and reference documents are contained within the text of the individual sections as appropriate. The PDA should emphasize the scope of each section consistent with the magnitude of the particular development project and the degree of advancement of the development.

Each section is concluded with a check list which emphasizes the major points of the section.

This Guide may be employed in preparing TDPs in response to a Specific Operational Requirement (SOR), Advanced Development Objective (ADO), or in preparing revisions to existing TDPs. Comments are included in each section indicating the applicability of that section to each type of TDP. It should be noted that certain portions of the TDP may not be required in a TDP which is in response to an ADO. In most cases this depends upon the type of system or equipment being developed.

For the sake of clarity and continuity there may be an overlap of required information among the various sections of the TDP as indicated in this Guide. It is not intended that material once included be repeated, however, appropriate reference should be made as to the location of this type of information in the document.

The TDP is *THE* plan for the guidance and conduct of the RDT&E phases of systems. It provides the R&D inputs to the Project Master Plan (PMP) which is the plan for the guidance and conduct of the whole life cycle of systems. The PMP has been structured along lines best suited to overall project management through the full-life cycle. The TDP is structured along lines best suited for R&D Management. While the two structures differ, TDP sections can, and are intended to be, inserted intact in the PMP together with comparable planning for the Production, Installation and Logistics Support phases when the latter planning has been accomplished.

This Guide is intended to provide assistance to personnel responsible for the preparation of TDPs. Its objective is to provide guidance for the evolution of comprehensive planning sufficiently standardized to provide management with sound decision information. It is not a substitute for prudent engineering and management judgment.

It is intended that this Guide will be periodically revised and updated to meet the varied needs of groups with the NMSE. In view of this fact, comments or recommendations concerning the content of this Guide should be forwarded to the CNM at any time for consideration.

This publication has been reviewed and approved in compliance with SECNAVINST 5600.16.

Deputy Chief of Naval Material for
Development/Chief of Naval Development

SECTION 1

Cover Sheet and Table of Contents

TECHNICAL DEVELOPMENT PLAN FORMAT

1.0 Cover Sheet

A cover sheet shall be prepared using the following format:

TECHNICAL DEVELOPMENT PLAN—_____.

Supports SOR/ADO (PROJECT NAME).

Element Number—_____.

*Project Number—_____.

Original Issue—_____.

Latest Previous Revision—_____.
(omit if original or first revision)

Current Revision—_____.
(omit if original)

Contract Definition completed—(date)
(omit if not applicable)

Bureau of _____ and/or Project Office

Department of the Navy

Washington, D.C. 20360

Copy No. _____ of _____ Copies (For Secret and Top Secret)

1.1 Table of Contents

The following table of contents shall be included:

*Use only if Project Number is different from TDP number.

TABLE OF CONTENTS

*In the case of a TDP responsive only to an ADO, some of these sections may not be required (see applicable section of this guide). Other sections are still to be numbered as indicated here.

1.2 Page Identification

Pages shall be numbered consecutively by section, i.e.; 1.1, 1.2, 2.1, 2.2, 2.3, etc. In addition, the TDP number, date, and classification shall be placed at the bottom of each page including the cover sheet and the table of contents.

SECTION 2

TDP Summary

DIRECTIONS FOR COMPLETING THE TDP SUMMARY

2.0 General

The TDP Summary (OPNAV Form 3910–3) extracts the TDP data of most significance to the ASN(R&D) and the DCNO(D) in the performance of their RDT&E management responsibilities.

Page 2.1 of the TDP Summary (Figure 2–1) is primarily descriptive. It identifies a project and briefly describes its development in terms of the most significant processes and resource expenditures planned. The data on this page is relatively static and reflects FYFS&FP targets. Minor changes may be delayed until the annual updating of the TDP. Significant changes require an early submission of a new page to reflect changes in time or money. When different models under a TDP are being developed with markedly different time or funding schedules, a separate Figure 2–1 is desired for each model.

Page 2.2 of the TDP Summary (Figure 2–2) is designed to assist in the measurement of progress. The most significant events for the entire development and early installation periods and for the coming fiscal year are identified and scheduled. Actual progress is measured against planned progress through to comparison of the Monthly Project Evaluation (OPNAV Form 3910–4) and subsequent revisions of the TDP Summary against the original schedule.

Figure 2–3 is the Quarterly Project Reliability Summary, OPNAV Form 3910–5, adapted to serve as a part of the TDP Summary. In this summary actual month by month progress is measured against planned progress through the MPE's report of progress toward meeting the reliability engineering goals stated for the project and summarized in this form.

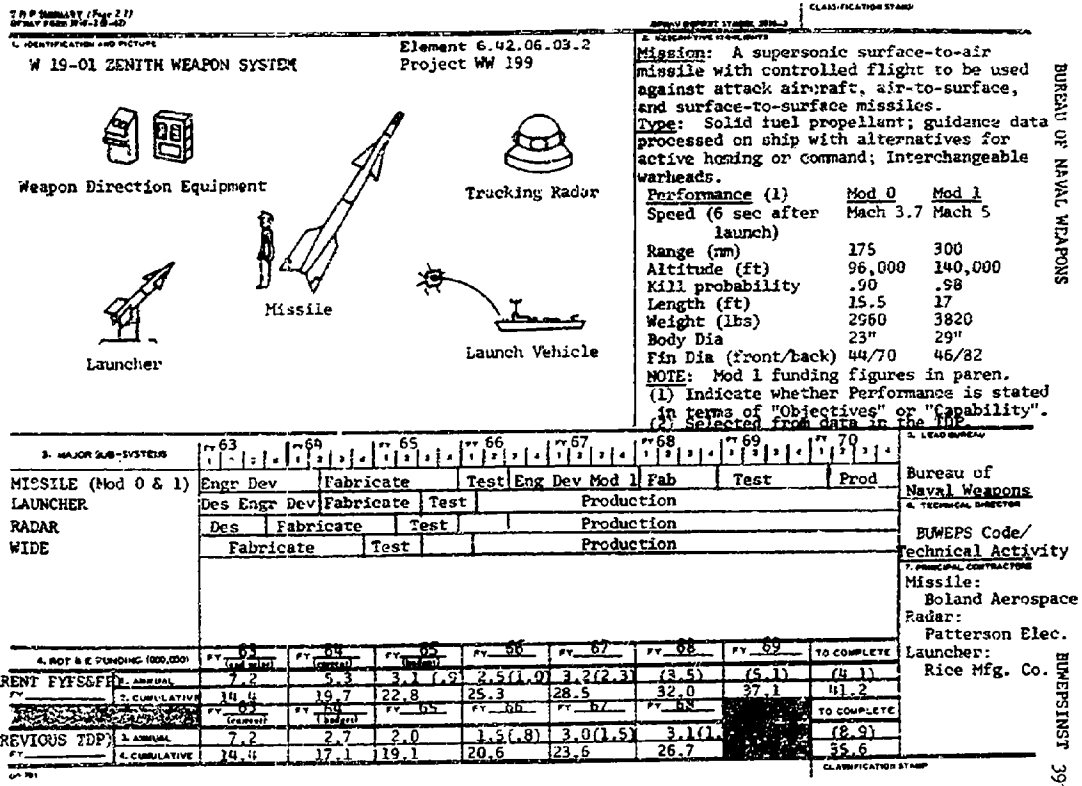
The data from the hypothetical weapon system included in the sample form is intended to be illustrative and not restrictive. More detailed guidance is contained in the instructions which follow.

2.1 Specific Instructions for Completing OPNAV Form 3910–3

a. *Block 1.* Insert a line drawing of the system, including the major components. Include a man silhouette to indicate relative size. Place the TDP number, Title, DOD Element Number in a prominent position. Show the RDT&E project number only if it differs from the TDP number.

b. *Block 2.* Use brief statements to convey pertinent characteristics of the system. Cover such areas as mission, performance highlights, dimensions, and oporational description.

c. *Block 3.* Insert the fiscal years on the time scale from the inception of the project through the completion of RDT&E effort. If this span extends over more than eight years, show initially the first eight years of functional



TDP W 19-01
1 April 19XX

BUREAU OF NAVAL WEAPONS

BUWEPSINST 3910.2B

Figure 2-1. TDP Summary, OPNAV Form 3910-3 (Page 2.1).

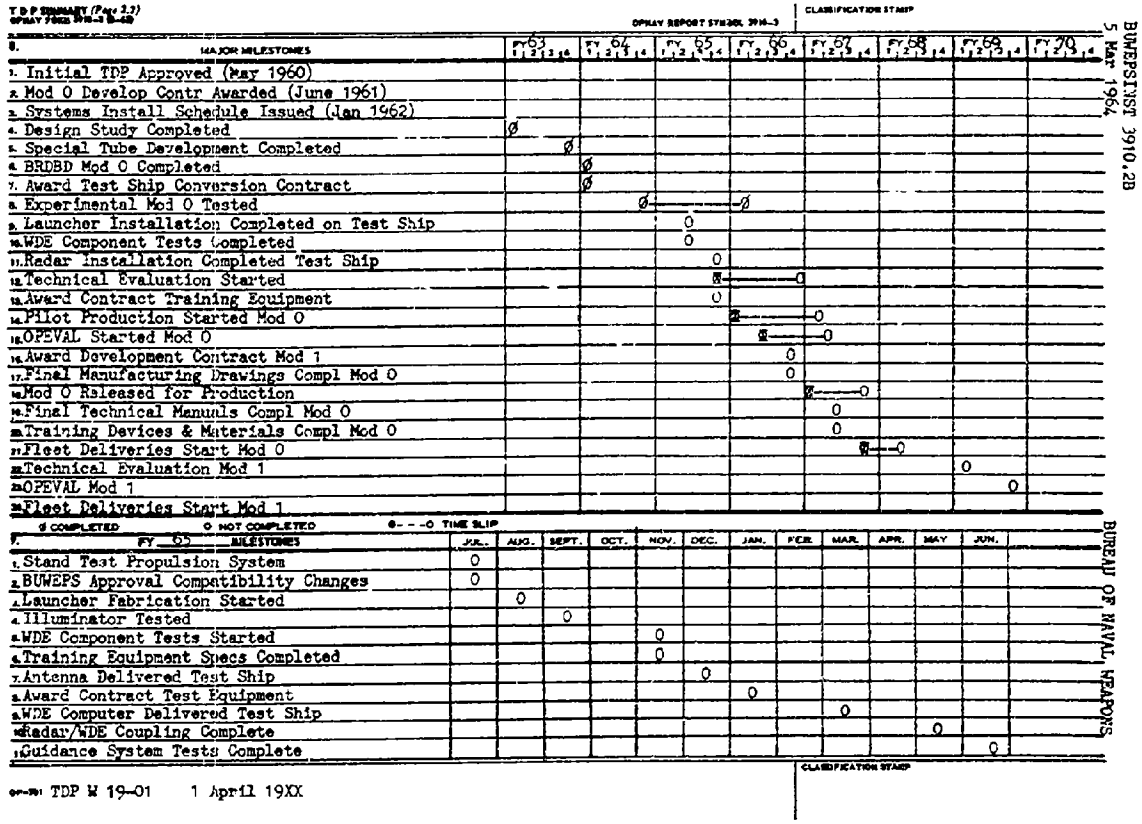


Figure 2-2. TDP Summary, OPNAV Form 3910-3 (Page 2.2).

QUARTERLY PROJECT RELIABILITY SUMMARY
OPNAV FORM 3910-5(A-B)

REF. OPNAVINST 3910.1S
OPNAV REPORT SYMBOL 3910-7

CLASSIFICATION STAMP: UNCLASSIFIED

1. SYSTEM/PROJECT NUMBER AND NAME: W19-01 Zenith Weapon System (WW-199)

ELEMENT: 6. 42. 06. 03. 2

DATE: 1 April 19XX

	4. MINIMUM ACCEPTABLE RELIABILITY REQUIREMENTS	5. CONTRACT GOALS	6. LATEST PROJECTED RELIABILITY	7. CURRENT ACHIEVED RELIABILITY	NOTES
2. OVERALL SYSTEM	80% chance that single one square meter target will be acquired at 200 miles LOS and shot down with one round.	Kill probability on single target 0.98	Kill prob. 0.70		
3. SUB-SYSTEMS					
Missile	85% chance that unit checked out on launcher will hit 1 sq. meter target witnin design envelope.	90%	85%	70%	2
	85% chance that unit will check out on launcher	95%	75%	45%	3
Launcher	Reliability 98% when installed on deck on 90 day mission in North Atlantic Winter or Tropic Summer	99.5%	99.5%		
Radar	90% availability during 3 month cruise	95%	85%	50%	4
	90% reliability during 4 hour GQ	200 hr MTBF (98%)	80 hr MTBF (95%)	26 hr MTBF (85%)	5&6
WDE	95% reliability during 4 hour GQ	200 hr MTBF (98%)	38 hr MTBF (90%)		

NOTE 1. RELIABILITY IS NOT GIVEN TO A CONFIDENCE LEVEL OF 0.8/ CONSISTANT WITH DATA IN Vol. 5 of 6.

2. Based on test firing of 100 prototype missiles.
3. Based on pre-flight checking of 150 missiles the first time they were placed on launcher after being uncrated and serviced.
4. Based on availability of radar during 30 day period of test firings.
5. Based on 1000 hour accumulated time on prototype radar.
6. For this purpose the radar is considered not to have failed if it will track a one square meter target at 250 miles LOS.

USE OPNAV FORM 3910-5C(continuation sheet) FOR ADDITIONAL SUB-SYSTEMS AND APPLICABLE NOTES

CLASSIFICATION STAMP: UNCLASSIFIED

Figure 2-3. Quarterly Project Reliability Summary, OPNAV Form 3910-5.

activities. In each subsequent annual revision drop the year just completed from the time scale until the estimated final year of major RDT&E activity is shown. The final eight years will be displayed through the remaining revisions of the TDP Summary.

List the major sub-systems. Under the time scale show the primary functional activities: design, engineering development, fabrication and testing. Identify the functional activities in the manner illustrated. Insert vertical lines at the approximate times that a new activity occurs. Omit the production phase in the case of ADOs.

It is recognized that beginning and ending dates for these activities are not always precisely defined and that a certain degree of overlap may exist for different components within a sub-system. Portray only that functional activity which is most dominant within the sub-system at one point in time.

d. *Block 4.* The objective of this block is to provide a financial profile of the project funding which will give a continuous retraceable history and projection during the course of the development.

(1) Summarize in line 1 the RDT&E funding data from the latest approved FYFS&FP. If these figures appear in a published FYFS&FP document, give the date of this document in the line 1 blank. If the figures reflect an approved Program Change Proposal (PCP) that has not yet appeared in the FYFS&FP document, give the date of final OSD approval of the PCP. If the figures reflect a Navy approved, below-threshold, reprogramming action, give the date of this action. Each of these three items constitute a part of the "Approved FYFS&FP." Unless the funding data given is that shown in a published FYFS&FP document, note the reference that effected the change.

(2) Show in line 2 the cumulative funding through each fiscal year as based on line 1.

(3) Show in lines 3 and 4 the equivalent line 1 and 2 figures from the TDP Summary of the TDP submitted on 1 April of the previous year.

e. *Block 5.* Identify the PDA. This Bureau or Office is responsible for submission of the TDP.

f. *Block 6.* Name the technical direction activity for the project.

g. *Block 7.* Name the principal contractors for the project. Distinguish between prime and sub-contractors if such be the case.

h. Insert the TDP number, date of submission and page number at the bottom of the page.

i. *Block 8.* Treat the time scale in the same manner as that in Block 3. Include all of the following common milestones which may be *appropriate* to the development project.

Initial TDP Approved
Personnel Research Started
Development Contract Awarded
Systems Installation Schedule Issued
Design Study Completed
Special Tube Development Completed
Experimental Model Tested
Training Plans Conference Held

Training Equipment Contract Awarded
TECHEVAL Started
OPEVAL Started
Released to Fleet Production
Final Technical Manuals Completed
Training Devices and Materials Completed
Fleet Deliveries Started

If the milestones extend beyond the eight years for which space is available, type the planned dates in the last column.

Intersperse among the common milestones additional milestones which represent key events in the project. Such milestones should be clearly defined, discrete, and unequivocal events. If it is desired, the additional milestones may be listed by sub-system groupings immediately following the chronological list of common milestones. Show no less than a total of 20 common and additional milestones in Block 8.

When revising the chart, show completions and slippages according to the legend beneath the chart. Show time gains by reversing the slippage symbols. Each revision of the Block 8 major milestone schedule should contain the "O" marking of the original TDP and each subsequent revision, complete with appropriate slippage indication marking. Block 8 will therefore contain a time history of the development.

j. *Block 9.* Insert the fiscal year date. List the most significant events planned for the fiscal year. Include in this chart the appropriate events listed in Block 8. Intersperse additional fiscal year milestones, including those for personnel support as appropriate, so as to permit an approximate month by month evaluation of progress. Show no less than 9 milestones. The Monthly Project Evaluation (OPNAV Form 3910-4) will be plotted against these milestones to compare planned and actual progress. The last column is for use by DCNO(D) (Op-07) project monitors.

2.2 Specific Instruction for Completing OPNAV Form 3910-5. (Used as third page of TDP SUMMARY. For this use, the word QUARTERLY in the title will be blocked out.)

a. *Block 1.* Project identifying data as per sample. The project number shown last in parenthesis is to be omitted unless different from TDP number. "Date" to be the same as the date of the TDP it summarizes.

b. *Opposite Block 2.* The reliability values called for in blocks 4, 5, 6, and 7 are to be entered for the overall system as they become available throughout the life of the development. If different values apply to different modes of operation they should be listed separately.

c. *Block 3.* The sub-systems are to be listed. The appropriate reliability values are to be shown opposite each sub-system.

d. *Block 4.* Here are to be shown the latest APPROVED Minimum Acceptable Reliability Requirements. In the initial TDP submission, these should normally be those called out in the SOR or, if any, in the ADO. For subsequent revisions the value called out in the latest approved TDP should be shown together with any recommended change in this current revision.

e. *Block 5.* The "contract goal" values possibly may not be firm in the

initial submission; however, the planned goals should then be shown and so labeled.

f. *Blocks 6 & 7.* These blocks are to be filled in with the latest information available at the time of preparation of the TDP revision.

g. Insert the TDP number and page number at the bottom of the page.

h. For further information on the features of this form, refer to the current edition of the OPNAVINST 3910.15 series.

i. In the case of a TDP responding to an ADO not leading to experimental hardware where a Reliability and Maintainability Plan, SECTION 10, is not required, this form is not required in the TDP Summary.

2.3 Optimum Development Planning Summary Sheets

A Supplemental TDP Summary Sheet which reflects optimum development planning and scheduling should be prepared and submitted concurrently with TDP revisions as an attachment to the forwarding letter. This will be in addition to the primary TDP Summary Sheet which shall reflect FYFS&FP targets. (This action will not be required for initial TDP submissions, which shall cite optimum development planning and scheduling data on the TDP Summary Sheets.)

When the Supplemental TDP Summary Sheet is not self-explanatory, an explanation and justification of the supplement shall be provided in the forwarding letter.

In those instances wherein the explanation and justification are contained in the TDP, the forwarding letter need cite only the appropriate part(s) of the TDP in lieu of reiterating this information in the forwarding letter.

In those instances wherein optimum development planning and scheduling correlate with the FYFS&FP, the forwarding letter will so state.

To insure that the above Supplemental Summary Sheets are not inadvertently confused with other TDP Summary Sheets, stamp or otherwise imprint diagonally across the face of each sheet the following information in bold lettering: "PLANNING ONLY. THIS DOCUMENT DOES NOT REFLECT FYFS&FP DATA" (as shown in Figure 2-4).

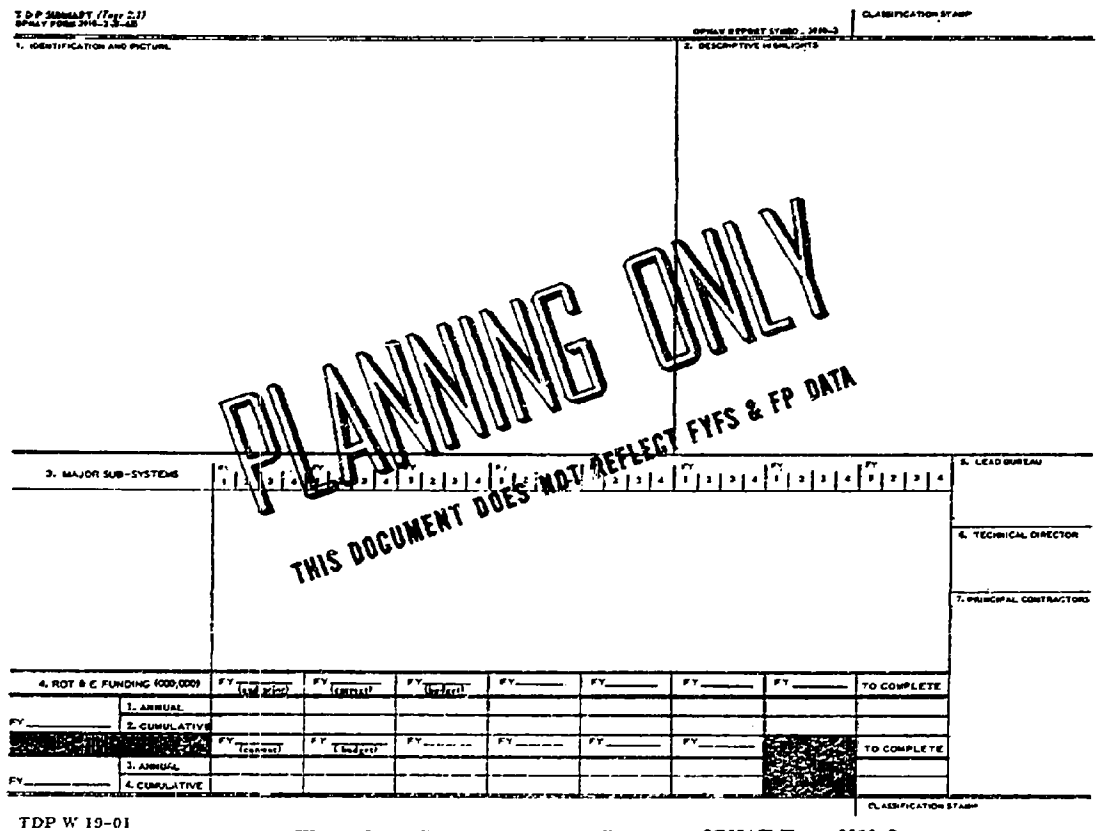


Figure 2–4. Supplemental TDP Summary, OPNAV Form 3910–3.

SECTION 3

Index of Effective Pages

3.0 General

An index of effective pages shall be prepared using the following format:

PAGE	EFFECTIVE DATE	PAGE	EFFECTIVE DATE
1.		9.1	
2.1		9.2	
2.2		10.1	
2.3		10.2	
3.1		11.1	
3.2		12.1	
4.1		13.1	
5.1		14.1	
6.1		* Appendix A	
7.1		(Submit a new list of effective pages	
8.1		with each revision)	

In general, all pages of a particular revision shall bear the same date.

* SORs and ADOs are reissued as whole new replacement documents and do not normally have individual page changes.

SECTION 4

Narrative of Requirement and Brief Development Plan

4.0 General

SECTION 4 is the nucleus of the TDP which provides a basis for the entire project as described in the other sections. As such, its composition must be designed to provide a foundation for the other sections. (Throughout SECTION 4, periodic references should introduce the other sections, tying them to this section and to one another.)

Care should be taken in the writing of this section due to its critical role in the TDP and due to the fact that reviewers will often peruse SECTIONS 4 and 6 to obtain a quick assessment of the scope of the development, the requirement(s) which gave rise to the development, and the cost of the project.

4.1 Statement of Requirement

The project development being described in the TDP will normally be in response to a Specific Operational Requirement (SOR) or an Advanced Development Objective (ADO). To set the stage for the project to be described, the SOR or ADO is attached to the TDP as Appendix A. (See Appendix B—Steps in System Development.) If inclusion of the SOR or ADO as Appendix A will in itself raise the military security classification of the TDP, it should be cited and provided separately on a need-to-know basis.

Specific requirements should be extracted from the requirement document and technically analyzed with regard to the actual threat which exists and the capabilities of the proposed development to meet that threat. A convenient form for comparison is a table which lists the characteristics of the threat (or operational requirement) and the proposed characteristics of the system. This table should be composed in such a manner as to make it a focal point of the TDP. Use exact quotations from the ADO or SOR, if possible, to strengthen the presentation in this section.

(See OPNAVINST 3910.6 series, Specific Operational Requirements (SOR) and Tentative Specific Operational Requirements (TSOR), instructions for preparation of, for the detailed content of an SOR document.)

Wherein the guidance received in the ADO or SOR is considered to be insufficient to provide a sound basis for system development planning, the operational and engineering assumptions made by the PDA shall be cited in this subsection. The engineering assumptions normally are not included in the requirements documents and thus should be included in most TDPs. When operational assumptions have been confirmed or superseded by subsequent revision to the appropriate requirements document, they should be deleted from this subsection in the subsequent revision to the TDP.

4.2 Existing and Future Capabilities

In this subsection, the goals of the SOR or ADO should be thoroughly examined to determine if these goals can realistically be attained in light of financial, personnel, schedule, and technical limitations which may exist. Much of this analysis may have been previously conducted for the Proposed Technical Approach (PTA) submitted in response to a TSOR for this project. If such is the case, reference to the PTA may be made in lieu of further documenting this information in the TDP. However, due consideration should be given to the discussion in the paragraphs below, regarding the importance of this information, before a decision is made to merely reference the PTA.

First, describe any currently existing capability in areas relating to the SOR or ADO. Make detailed comparisons between goals of the SOR or ADO and such existing capability. A tabular form is again useful in summarizing the existing capability. This table should be identical to the table used in Section 4.1 in regard to SOR or ADO goals.

Next, the differences in each characteristic between the existing capability and the required capability should be analyzed to determine if the goals are realistic in light of the existing capability and the state of the Art. The feasibility of achieving each goal should be explored in terms of the technological position existing and the new techniques which may be applied to the development to achieve the goals.

In general, new technology stems from basic and exploratory research and development undertaken prior to the system developments which are the subject of TDP's. Due to the risks inherent in achieving it, any new technology required for the system development must be identified and discussed sufficiently in the TDP to permit management decision on pursuing the proposed project. If newly established technology is being applied for the first time in the TDP project, this fact should be stated and an assessment of the risks involved should be presented.

If systems exist which have closely related characteristics to the SOR or ADO goals, these systems should be described in regard to these characteristics. Some of these systems may be replaced by the new system, and, therefore, a detailed comparison of old and new systems should be made with particular emphasis on operating costs, vulnerability, maintainability, reliability, and required manning level and training requirements. (At this point, the basis for the detailed descriptions in SECTIONS 10, 11 and 13 is established. Summarize these characteristics on a comparative basis.) NMSE and other support activities should have major inputs to this effort.

Obvious advantages can be achieved and considerable confidence in the outcome of a new system development can be conveyed if the TDP reflects that maximum possible use is made of existing, proven components, designs, or techniques. Marginal improvements in components which may involve the expenditure of considerable resources may otherwise be involved.

If systems are in development which may appear to meet the SOR or ADO goals but in reality do not, they should be described herein. Particular emphasis should be placed upon pointing out where the characteristics of these systems do not meet established goals of the SOR or ADO.

The comparison of the characteristics of the new development system and the characteristics of existing or other development systems should be thoroughly considered. It is in this area that potential critics will find arguments to question the new undertaking. Only if the PDA is explicit in pointing out the shortcomings of other systems can justification for the new development be established beyond doubt. Avoid criticism of existing Fleet systems, components, and techniques unless a significant purpose is served thereby and quantitative comparison can be made. Give consideration to the fact that existing systems are contributing to military effectiveness, whereas new development systems are potential contributors only.

The last part of this subsection should be devoted to describing any special features of the new system not discussed during previous comparisons. The new system should be described in general, detailing its characteristics and its ability to meet all the SOR or ADO goals. Other characteristics which should be considered are, for example, other applications to problem areas not defined in the SOR or ADO, useful operational life and potential to grow to meet expanded threats.

If certain goals of the SOR or ADO cannot be met within the frame of the development, the cause of this problem, be it financial, personnel, technological or schedule, should be stated. Possible alternate plans which may involve revision of the funding level or schedule should be described. If parallel work effort is a potential solution due to the uncertainty of choosing or successfully developing a particular plan of development at this time, this solution should be presented. Certain problems may exist at the time of TDP preparation the solution of which is dependent upon work in progress. A clear-cut plan for solution of these problems may not be possible until this in-progress work is completed. Problems of this type should be described here.

4.3 Design Characteristics

State the design characteristics of the new development in response to the requirements of the referenced SOR or ADO. Specifically relate the design characteristics to the SOR or ADO goals. (This is important; to constantly relate to operational goals.)

State any additional characteristics of the new system which may have evolved as a result of a detailed operational analyses or other studies which followed the establishment of the requirement. These may include, for example, any expansion of capabilities beyond the SOR to make the system more versatile, accurate, or reliable, at moderate cost increase, thereby obtaining a high potential return for low expenditure. Very often, capability in excess of SOR or ADO goals can be achieved at no extra cost. This additional capability provided by the new development should be described. The decision to include or not to include this type of input should be made under cost effectiveness criteria.

The cost effectiveness of the new development should be explored to determine if planned expenditures are warranted and if a potential exists for increasing effectiveness at moderate cost increase. Any effort beyond minimum acceptable goals are justified only under cost effectiveness criteria.

Certain design characteristics may have been defined based upon assump-

tions made in areas where the SOR or ADO is not adequately definitive. These assumptions must be described and any tradeoffs considered when making these assumptions clearly explained. The impact on system design caused by later definition of the unknowns should be described. A plan should be described to define critical areas having great impact on system design and therefore having potential to seriously effect overall program planning. These critical areas must be clearly highlighted.

Examples of such critical areas are the explosive shock and blast resistance required in system components exposed to combat conditions and ECM/ECCM considerations. Where pertinent, the TDP should discuss requirements in these areas whether or not specified in the SOR or ADO document, both with regard to the basis of decisions determining the requirements and, where applicable, with regard to the technical approach for achieving and verifying the achievement of design capabilities.

Special attention should be given to those areas which require experimental or investigative effort in the field of special competence of specific bureaus or offices of the Navy not a part of the NMSE. There are, for instance, certain development projects which require specific oceanographic support during RDT&E. The knowledge or special efforts necessary in direct support of the development must be identified and included in the TDP. The planning for obtaining the special support necessary shall be done in collaboration with the bureau or office of special competence; in this case, the Oceanographer of the Navy. The TDP should clearly set forth the effort required and services anticipated. The funding implications of the special support effort should be set out in SECTION 6, the Financial Plan. If the special support is so extensive as to require especially complex planning, a SECTION 15 may be used in the TDP appropriately titled to indicate its content.

4.4 Historical Brief

Give a brief description of the evolution of the project from its inception to the date of writing of the TDP. Call out major milestones which have passed during the course of the project stressing the relationship between these milestones and their importance in achieving the goals of the development. Both technical and administrative milestones should be described. Management controls which have been initiated should also be included.

Any special correspondence from key officials relating to the project should be summarized or included among the appendices.

FOR TDPs WHICH RESPOND TO AN ADO SHOW A MILESTONE AS TO WHERE POSSIBLE CHANGEOVER TO AN SOR TYPE DEVELOPMENT MIGHT OCCUR. Similarly, all TDP's should cite the critical appraisal milestones where decision to continue, to select from alternative paths, or to cancel should be made.

4.5 Development Plan

Describe what has occurred in the project to date, making reference to the milestone chart of Section 2.1. Indicate all studies and developments which are under way and the cognizant agency or contractor for each task.

After establishing this frame of reference, describe the major developments,

test programs, production, installation and construction programs which have yet to be undertaken to complete the project. Specifically, point out areas of interdependence of tasks and show where parallel or serial effort can be employed.

Where interdependence exists show how this relationship affects each area involved. If the course of any development can have serious impact upon the outcome of another development, plans should be described to monitor project progress to prevent catastrophic events from occurring. Show how the dependent project can be redirected if the expected input from a related project is late or possibly non-existent.

Detail each of the major tasks to be accomplished, briefly describing the ultimate goal of each task, the potential solutions and the course to be followed to complete each task. Each task should be functionally grouped, i.e., development, production, test, training, etc. (In this subsection, SECTIONS 12 and 14 of the TDP should be introduced to tie the TDP together. SECTION 5 is also introduced when describing the expected development plan and the techniques for controlling the developments.)

Finally, state the technique to be employed to accomplish each task. If a contractor will be employed, state the expected type of contract and if of the incentive type, indicate which performance factors will be used to determine incentive elements in the contract.

SECTION 4

Narrative Requirement and Brief Development Plan

1. Has the SOR or ADO been attached to the TDP as Appendix A?
2. Have specific requirements been extracted and a comparison made between requirements and threat? In tabular form?
3. Have SOR or ADO goals been analyzed and determined to be feasible and/or reference made to an applicable PTA?
4. Have existing capabilities been compared to goals? In tabular form?
5. Have improvements over and above existing capabilities been pointed out?
6. Have existing systems been described?
7. Have systems in development been described?
8. Have all special features of the development been itemized?
9. Have problems in meeting SOR or ADO goals been defined?
10. Have all pertinent design characteristics of the development been defined?
11. If special support outside the NMSE is required, has planning been done including the preparation of SECTION 15 if deemed appropriate?
12. Has the cost/effectiveness characteristic of the development been analyzed?
13. Are all assumptions made and clearly defined?
14. Have past major milestones been summarized in chart form?
15. Have major tasks which are underway been described?
16. Have major tasks yet to be undertaken been defined?
17. Has the interrelationship of various developments been clea / indicated?
18. Has the impact of interdependent tasks on ultimate project completion been evaluated?
19. Have planned contracting awards been described?
20. Have personnel and training requirements been analyzed for their effect on human resources feasibility of the system?
21. Have explosive shock and blast requirements and other similar critical areas been considered and discussed in the TDP from the standpoints of decision basis and development planning?

SECTION 5

Management Plan

5.0 General

The purpose of this section is to provide a description of the management techniques that will be used to manage the development, including the principal factors considered in choosing techniques.

The various sections of the TDP are designed to (a) describe design characteristics of the new development in response to the requirements set forth in the SOR/ADO and (b) prepare a series of plans (Reliability and Maintainability, Operability and Supportability, Test and Evaluation, Personnel and Training, and Production Delivery and Installation) for verification that the base-line objectives are obtained during the development, production, and operational phases of the project. The Management Plan will set forth the means by which the above mentioned plans are monitored and controlled. It is the technique used by the PDA in planning, organizing, directing, and controlling the parameters of time, cost, technical performance and human resources. Full use should be made of supporting activities in developing the management plan in order to provide for the expeditious achievement of project requirements.

PERT/COST, PERT/TIME, Expenditure Milestones, and Line of Balance are examples of management techniques used to manage projects.

5.1 Progress Reporting and Control

There are many management control processes in use today on Navy projects. These range from formal and informal verbal and documented reports to specialized control processes including automatic data processing and transmission procedures. The PDA must determine the particular management system best suited to the project for which it is responsible. Each development project must be carefully examined as to budget stature and complexity in determining the management system best suited for the particular development effort. The criteria for selection or design of a good management control system include:

(a) The management control system must satisfy the needs of the project;
(b) It must be flexible to project changes;
(c) It must be understandable to those responsible for its implementation;
(d) It must be worth the cost of operation;
(e) It must provide timely and accurate information;
(f) It must show where and why failures occur if corrective actions are not taken.

5.2 Management Control Systems

The management system or combination of management systems selected by the PDA should be described. The principal factors considered in making

the selection should be enumerated. All new contracts of the cost-reimbursement or fixed price incentive types estimated to exceed one million dollars are strong candidates for the PERT/COST system. Contracts of less than one million dollars of the cost-reimbursement or fixed price incentive type should require expenditure milestone report or PERT/COST if this system is in voluntary use as a regular company practice. New firm fixed price contracts should require PERT/TIME or Line of Balance report as appropriate.

If PERT/COST is indicated and is not selected as the basis for management control adequate, explanatory information should be submitted.

(a) *Guideline for PERT and Expenditure Milestones*

Although when to use a specific management control system is often determined by the type and complexity of the development project, certain thresholds are applicable to PERT and Expenditure Milestones. Detail implementation requirements for these two control systems are defined in MIL-P-23189A and MIL-M-23127.

Figure 5-1 indicates the threshold requirements for the implementation of PERT and Expenditure Milestones.

5.2.1 System Description

Following is a brief description of the basic systems that are applied to development projects.

(a) *PERT/TIME*

The PERT/TIME System is a management information system for planning and control for evaluation of progress versus plan as to time only, which is based upon a time dependency network of the project plan.

It employs:

1. A product oriented work breakdown structure beginning with these objectives subdivided into successively smaller end-items;
2. A network plan consisting of all the activities and events that must be completed or accomplished to reach the project objectives, showing their planned sequence of accomplishment, interdependencies, and interrelationships;
3. Elapsed time estimates and identification of critical paths in the networks;
4. A schedule which attempts to balance the objectives, the network plan, and resources availability;
5. Analysis of the interrelated networks, schedules and slack values as a basis for continuous evaluation of program status, forecast of overruns, and the identification of problem areas in time for management to take corrective action.

(b) *PERT/COST*

The PERT/COST System, a complement to the basic PERT/TIME System, was developed to provide planning and control for evaluation of progress versus plan as to both time and cost, which is based upon a time dependency network of the project plan and costs related to work packages which are part of the network. This interrelation, a significant feature of the PERT/COST System, permits more accurate

PROGRAM CONTROL TECHNIQUE	APPLICABLE SPEC. AND BOILER/PLATE	APPLICABLE TO		WHEN USED	★INFORMATION REQUIRED	WHEN REQUIRED	SUBMITTED TO
		CONTR	GOVT ACT				
PERT/COST	BuShips Inst. 4330.30 series MIL-P-23189A	X	X	1-Contracts/Problems near $1,000,000 and 1 year, or greater 2-Contracts/Problems which have strong impact upon successful and timely accomplishment of program goal, where there is uncertainity as to time — cost 3-Other instances when considered desirable by management 4-PERT/TIME requirements of MIL-P-23189A to be used on Fixed Price Contracts	Preliminary Network with Planned time (per activity) Planned costs Work Breakdown Structure	With Proposal	Contracting Ofcr ☆ Project Engineer PMC Data Proc. Center
					Work Breakdown Structure Detailed PERT/TIME Network List of Work Packages with Planned costs for each PERT/TIME computer output ○	30 days after award or assignment	Project Engineer PMC
					Reports and Analyses PERT/TIME output/analysis ○ PERT/COST output/analysis ○ Technical Progress	Monthly, 15 days after close of financial records	Project Engineer PMC
					Revised Networks and/or Work Breakdown Structure	1-Immediately upon revision by performing activity 2-With proposed change in scope	Project Engineer PMC
EXPENDITURE MILESTONES	BuShips Inst. 4330.29 series MIL-M-23127	X	X	1-All contracts/problem of a research or development nature where PERT/COST is not used. 2-Not applicable to services, production, or fixed price contracts where overrun factor does not exist.	Preliminary Milestone Plan with Planned achievement dates and Planned cumulative costs for each milestone	With Proposal	Contracting Ofcr ☆ Project Engr PMC
					Final Milestone Plan with Planned achievement dates and Planned cumulative costs for each milestone	30 days after award or assignment	Project Engineer PMC
					DD Form 1097 Report of completed milestones Report of expected deviation	Monthly	Project Engineer PMC
					Revised Expenditure Milestone Plans	1-Immediately upon revision by performing activity 2-With proposed change in scope	

NOTES: ★ - General Requirements Only Detailed Requirements are provided in specification ☆ - Not applicable to Government Activities ○ - Or input data if Government computer facilities are utilized

Figure 5-1. PERT/COST and Expenditure Milestone Implementation Requirements.

measurement of project status. Following is an abbreviated description of PERT/COST benefits:

1. Whether or not the current estimated time and cost for completing the entire project is realistic;
2. Whether the project is meeting the committed schedule and cost estimate and, if not, the extent of any difference;
3. Whether requirements for manpower and other resources have been planned realistically to minimize premium costs and idle time;
4. How manpower and other resources can be shifted to expedite critical activities;
5. How manpower and other resources made available by changes in the project tasks can be best utilized.

(c) *Milestone Expenditures*

The Milestone Expenditures Plan consists of a series of clearly defined milestones with the proposed achievement time and proposed cost of each. Each milestone is a predetermined point of accomplishment which is clearly recognizable as an event which either does or does not occur at a predetermined point in time which can be priced out. For example, "Complete fabrication" is subject of interpretation whereas "Ship the developmental model" is not. Areas or phases known to be potentially controlling efforts or those known to be pushing the state of the art shall be carefully identified and milestoned.

(d) *Line of Balance*

Line of Balance is a scheduling technique for presenting in graphic form the current status (planned and actual) of the major elements of a production program. Utilizing the principle of exception, it permits management, at a glance, to identify those elements which are lagging and may delay delivery of the final product. It also shows what elements are on time or ahead of schedule. Thus, Line of Balance enables management to rapidly spot troublesome areas of the project and to take timely corrective action. Successively updated studies provide checks on the effectiveness of such action in order to keep the project on schedule. Line of Balance involves a simple graphical construction and requires no computations. It makes use of three items of information which are readily available. The first two are established at the start of contract performance. The third is obtained periodically from engineering and the factory. These information items are:

1. The contract delivery schedule which shows the cumulative number of units to be shipped against calendar dates. This is the objective of the project.
2. The production plan which shows the relative timing, within the production cycle of a single unit of the major elements of the manufacturing process.
3. The actual quantities produced of each of these major elements at the time the progress status is being evaluated.

A detailed description of the Line of Balance Technique and rules for its implementation may be found in NAVEXOS P1851 (Rev. 4–62).

5.3 Organization Chart

An organization chart should be prepared showing clearly the relationship of the PDA with both NMSE Supporting Activities and Other Supporting Activities.

Figure 5-2 illustrates the PDA's relationship to Supporting Activities.

5.4 Work Breakdown Structure (WBS)

The overall project should be broken down to an adequate level to assure that the design characteristics described in SECTION 4 in response to the SOR/ADO are identified. The WBS should then be further defined into lower levels of summarization to assure that all sub-systems are included in the management concept. SECTION 7 illustrates in pictorial form the relationship of the system to other systems or functions. As such, SECTION 7 and the WBS should be carefully compared to assure that all elements of the hardware portion of the project are identified.

In addition to the sub-system of the development project, the nonhardware portions of the project such as Personnel and Training should be included as part of the WBS.

The WBS will provide a basis for:

(a) defining and relating project objectives;
(b) summarizing cost;
(c) planning and scheduling;
(d) network construction.

Figure 5-3 illustrates a Typical Work Breakdown Structure.

5.5 Responsibility Matrix

To assure that responsibility for each portion of the project has in fact been recognized, a responsibility matrix should be prepared. Significant summary items on the WBS should be matched to a functional activity. In some cases it may be determined that more than one functional activity has cognizance over the summary end item in which case a decision as to ultimate responsibility should be made and indicated.

Figure 5-4 illustrates a Typical Responsibility Matrix.

5.6 Contractual Relationships

The means by which the project is contracted and the relationship of the PDA to NMSE Supporting Activities will affect the flow of schedule, cost and technical status information. The timeliness and reliability of status data tends to be degraded when the data passes through a number of organizational levels before reaching the PDA. The contract structure for the prime contractor(s) and sub-contractors, contract type, estimated contract value, and restriction on contract changes should be described.

5.7 Concept Formulation (CF) and Contract Definition (CD)

All new (or major modifications of existing) Engineering Developments and Operational Systems Developments as defined in DOD Instruction 3200.6; Reporting of Research, Development and Engineering Program Information, estimated to require cumulative RDT&E financing in excess of twenty-five

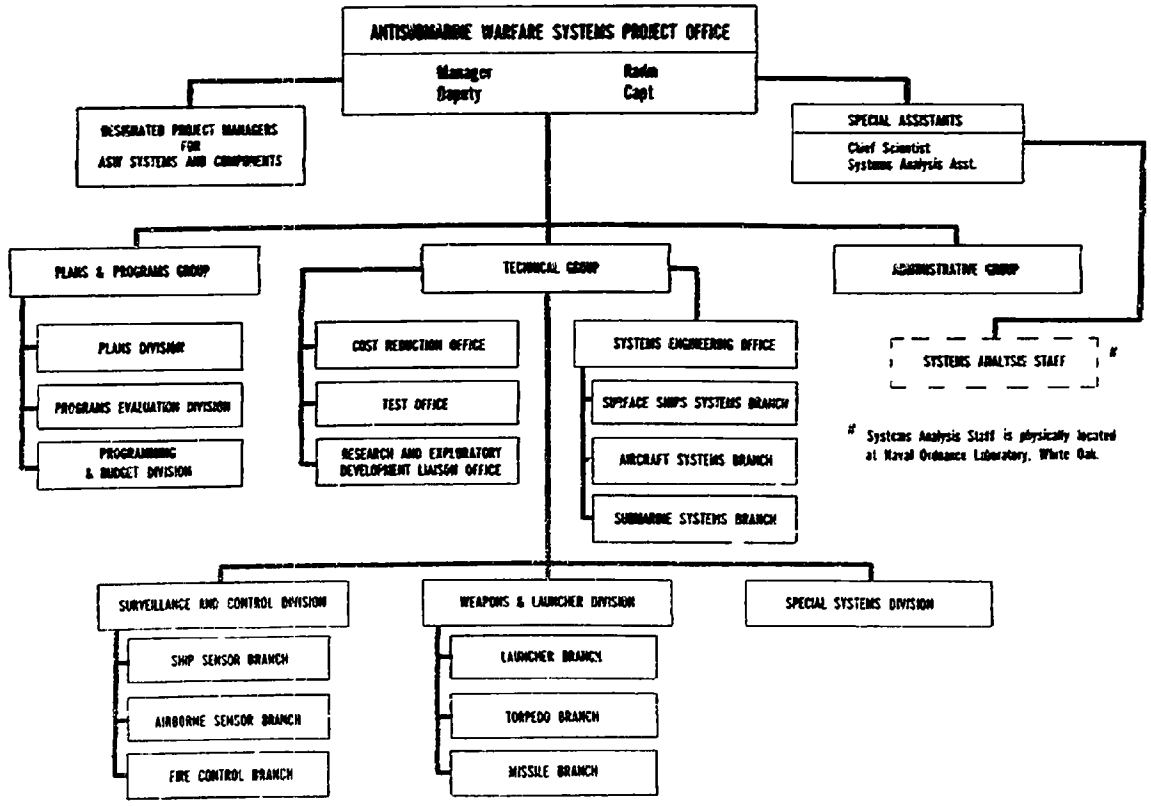


Figure 5-2. Typical Project Management Organization Chart.

Level Zero	Level One	Level Two
Material Annex/ Weapons Dictionary Item (Acft Weapon System)	Vehicle or Mission Equipt (A7A Acft)	Integration Structure Propulsion Electronics Payload (Missile only) Other
	Support Equipment	Operational Maintenance
	Systems Engineering	Systems Integration Reliability Configuration Management Value Engineering Maintainability Other
	Systems Testing	Operational Suitability Flight Vehicle/Support Equipment Compatibility
	Training	Services Equipment
	Site Activation	Military Construction Installation and Checkout
	Other	Documentation Industrial Facilities Production Facilities Production Equipment Lay Away of Production Base Advance Production Engineering Engineering Services

Figure 5-3. Typical Work Breakdown Structure.

million dollars, or estimated to require a total production investment in excess of one hundred million dollars, shall be conducted in accordance with DOD Directive 3200.9; Initiation of Engineering and Operational Systems Development, unless this requirement is specifically waived by written approval of DDR&E. This Directive requires that CF and CD be conducted.

CF describes the activities (formerly prerequisites to PDP) preceding a decision to carry out Engineering Development. These activities include accomplishment of comprehensive system studies and experimental hardware efforts

AIRCRAFT WEAPON SYSTEM MODEL ____ / WORK BREAKDOWN STRUCTURE	WBS LEVEL	MILESTONES	FUNCTIONAL ACTIVITY								
			BUREAU CODE			NAVAL ACTIVITY OR OTHER DOD/GOVT AGENCIES			CONTRACTOR OR SUB-CONTRACTOR		
			X	Y	Z						
WEAPON SYSTEM	0	S 3/19/64 C 12/31/67	√						A		
AIRCRAFT (Vehicle)	1	S 3/19/64 C 12/31/67	√	√					A		
STRUCTURE	2	S 3/19/64 C 11/16/65		√					A		
PROPULSION	2	S 5/1/64 C 12/1/65			√					B	
SUPPORT EQUIP	1	S 4/1/64 C 8/30/65		√							C
TRAINING DEVICES	2	S 3/19/64 C 4/1/66		√		NTDC L.I.			A		
RUNWAY CONSTRUCTION (Facilities)	2	S 5/1/64 C 6/30/65					BUDOCKS				
SPARE PARTS SUPPORT	2	S 3/19/64 C 8/15/67	√	√				Avia Supply Office	A		

Legend: S - Start date
C - Completion date

Figure 5-4. Typical Responsibility Matrix.

under Exploratory and Advanced Development, and are prerequisite to a decision to carry out Engineering Development.

CD (formerly Project Definition Phase) is that phase during which preliminary design and engineering are verified or accomplished, and firm contract and management planning are performed.

CD has been established as a logical procedural step for accomplishing an orderly transition from the conceptual to the acquisition phase. While the objectives and requirements expressed in the SOR/ADO and expanded in the TDP, have focused expanding technology and requirements in specific project objectives, considerable additional detail is required to assure that the Acquisition Phase can proceed on a minimum risk basis. As such, the definition effort represents an evolution and iteration in depth of the Conceptual Phase products. If the TDP is a plan for system development which is to be subjected to CF and CD, then included in this section shall be a plan for CF, as well as, a plan for the conduct of CD. In the past, the greatest number of problems and undue delays in conducting CD have resulted from the lack of adequate advanced planning. The importance of adequate advanced planning for CD cannot be overemphasized. It is not expected that these plans will be very definitive or detailed in the first issue of the TDP, however, subsequent revisions should become more so as plans materialize. For example, the TDP submitted in support of a Program Change Proposal for a project involving CD is necessarily limited in depth of planning and the CF will not necessarily have been accomplished. However, there should be firm plans for its accomplishment and the TDP should provide sufficient evidence that the CF will be completed prior to the request to initiate CD. Preliminary plans for the conduct of the CD should also be included in the TDP. When the request for approval for conducting CD (development in accordance with DOD Directive 3200.9) is submitted to DDR&E, an up-to-date TDP should accompany this request. This TDP should reflect the latest results of study and development work by in-house and industrial organizations and include a firm plan for the conduct of CD. As the project development progresses, plans for CF and the CD may be deleted when the plans are superseded by execution of these plans.

DDR&E has prepared a Department of Defense *Guide to Contract Definition* (Navy Publication No. 07P1). The PDA that is required to implement the CD effort should obtain a copy of this document.

It is not expected that plans and other material required by this section which has once been included in other sections of the TDP be repeated in this section. However, appropriate reference as to the location of applicable material within the TDP should be made.

5.8 Plan for Concept Formulation

It is anticipated that plans for CF as required by DOD Directive 3200.9, will probably be included in the Development Plan of SECTION 4, however, an appropriate cross-reference to this material should be made in this section. This plan should include information describing how each prerequisite requiring study or development efforts will be satisfied, including but not limited to, the tasks to be accomplished, methods of approach or technique to be employed, responsible organizations, and target dates, as appropriate.

5.9 Contract Definition

The plan for conducting CD should contain, but not be limited to, the following material:

(a) A narrative description of how it is planned to conduct CD, with emphasis on:

(1) Participation of DOD and contractor organizations and their relationship.

(2) A breakdown of sub-systems for which individual definition efforts are planned, together with the number of CD contractors planned for each and the type of contract planned for Phase II (e.g., fixed-price, fixed-price incentive, etc.).

(b) A summary of data supporting the projects' status as an Engineering Development or an Operational Systems Development, along with specific information showing that the prerequisites to CD have been met during CF. This may duplicate, amplify or reference the separate enclosures called for by DOD Directive 3200.9.

(3) Identification of approvals by the OSD and the Department that are required during CD.

(4) A schedule of milestones during CD, including decision points and the required approvals.

(5) Tradeoff studies to be made during CD.

(6) CD funding requirements.

(7) Proposal evaluation and source selection plan.

5.10 Project Management Flow

Each section of the TDP describes the plans that must be designed to provide effective response to the SOR/ADO. To tie together the various groups and activities which will participate during the total acquisition cycle a "Flow Chart for Project Management" Appendix E, has been prepared. This chart places the Preliminary TDP and the Final TDP in their correct time-phase relative to the total project and thus offers the opportunity to view the project as a complete entity. In addition, a chart of the steps in system development, Appendix B, is included. This chart describes the relationship between the major documents (NRR, EDR, SOR, TDP) prepared for projects.

TDP Check List

SECTION 5

Management Plan

1. Does the management control system selected fit the project objectives?
2. If development contracts are estimated to exceed one million dollars was PERT/COST selected?
3. Has an organization chart been prepared indicating relationship of the PDA to other NMSE Support Activities?
4. Has a WBS been prepared?
5. Does the WBS correlate with SECTIONS 7, 8, and 9?
6. Has a Responsibility Matrix been prepared?
7. How is the project to be contracted?
8. Is it required that the development be conducted in accordance with DOD Directive 3200.9? If so, has a plan for CF and a plan for CD been formulated and included?

SECTION 6

Financial Plan

6.0 General

The Financial Plan is to include all of the costs associated with the development, procurement, and operation of the system under development including personnel training cost estimates. The financial plan should agree with the latest approved FYFS&FP.

If the project is not in the approved FYFS&FP, the financial planning in the TDP will be based on the funding given in the SOR or ADO. The figures in the SOR will generally be based on those set forth in the PTA for the technical approach selected for development. If, in the preparation of a TDP to provide the capability set forth in the SOR by the specific fleet introduction date, it is found that the funds needed are substantially more than the estimates which went into the formulation of the SOR, the CNO shall be notified promptly in accordance with the "General" paragraph of the SOR. The notification shall contain recommended methods of rectifying the funding deficiency or of modifying the specified capability or project time schedule to fit the funding.

6.1 Specific Requirements

The financial plan should be divided into three parts as follows:

I. A breakdown of planned RDT&E costs including the RDT&E cost of personnel research and cost of training equipment.

II. A breakdown of production, delivery, installation, and operations cost estimates exclusive of training equipment. (Cost of initial coordinated ship allowance support (COSAL) issue of repair parts made in connection with fleet installation will be included in this part, if appropriate.)

III. A breakdown of personnel training cost estimates for operator and maintenance personnel, exclusive of RDT&E costs of training equipment but including production and installation costs of this equipment.

Each of the above three parts should consist of a tabulation of the appropriate cost estimates for each fiscal year under the applicable appropriation. In parts II and III of the Financial Plan, the sponsor of funds other than RDT&E funds (OPN, SCN, OMN, etc.) should be indicated. In cases where a bureau or office not a part of the Naval Material Support Establishment is involved in a project, the funds allocated to this bureau or office should be identified.

Figures 6-1, 6-2, and 6-3 are representative forms which can be used for the presentation of the Financial Plan. These are suggested formats and in some cases alteration of them to fit specific development projects will be necessary. However, the basic three part breakdown of the Financial Plan, as delineated above, should be preserved.

6.2 Other Requirements

If in revising the TDP it is determined that RDT&E funding does not reflect optimum planning and scheduling, an alternate TDP Summary (see page 2-8), OPNAV Form 3910-3, should be prepared. This alternate Summary Sheet and any required justification should be submitted with the TDP revision as an attachment to the forwarding letter and adequately identified as not reflecting present FYFS&FP status. Reference should be made in this section to the alternate Summary Sheet together with a discussion of the impact on the project if action indicated by the alternate Summary Sheet is not favorable. Any pending or projected PCP action on the project should also be noted.

FINANCIAL PLAN

TDP No. _____ TITLE _____

PART I

RDT & E COSTS (000 DOLLARS)

NO.	ITEM	RESP. AGENCY	FYXX	FYXX	FYXX	FYXX	FYXX	TOTAL
		TOTAL						

A. Appropriate Notes as Necessary
B.
C.

Figure 6-1. Representative Financial Plan—Part I.

FINANCIAL PLAN
PART II (000 DOLLARS)

NO.	ITEM	RESP. AGENCY	FYXX			FYXX			FYXX			FYXX			TOTAL
			EQUIP. PRODUCT.	COSAL	INSTALL & OPERAT.	EQUIP. PRODUCT.	COSAL	INSTALL & OPERAT.	EQUIP. PRODUCT.	COSAL	INSTALL & OPERAT.	EQUIP. PRODUCT.	COSAL	INSTALL & OPERAT.	
		TOTAL													

A. Appropriate Notes as Necessary
B.
C.

Figure 6-2. Representative Financial Plan—Part II.

FINANCIAL PLAN PART III (000 DOLLARS)														
ITEM	RESP. AGENCY	FYXX			FYXX			FYXX			FYXX			TOTAL
		OPN	OMN	ETC.	OPN	OMN	ETC.	OPN	OMN	ETC.	OPN	OMN	ETC.	
TOTAL														

A. Appropriate Notes as Necessary
B.
C.

Figure 6-3. Representative Financial Plan—Part III.

TDP Check List

SECTION 6

Financial Plan

1. Does the Financial Plan include all of the costs associated with the development, procurement, and operation of the weapon system, including personnel training cost estimates?
2. Do the totals on the Financial Plan agree with the latest approved FYFS&FP?
3. Has the three part breakdown of the Financial Plan been maintained as required?
4. If funds have been, or will be, allocated to a bureau or office not a part of the NMSE, has appropriate notation been made?
5. In the case of a revised TDP, does the RDT&E funding reflect optimum planning and scheduling? If not, has an alternate TDP Summary (OPNAV Form 3910-3) been prepared and properly submitted?

SECTION 7

Block Diagram

7.0 General

The purpose of the block diagram is to illustrate in pictorial form, the relationship between major components of the system and the relationship of the system to other systems or functions. In order to be effective it is important to keep the diagram uncluttered of lengthy descriptions and most titling should be kept to one or two words.

Each major sub-system or function should be shown as a block with its appropriate title appearing within the block. To emphasize the importance or physical size of any function, a larger block than others should be used. Functions which interface with each other should be connected by lines.

Interfaces may take on a number of forms which may be physical, such as electrical or mechanical interfaces, or non-physical, such as an information flow. A single line should be used to connect each block which is related to another block for each type of interface. Connecting lines should be coded on a legend on the drawing and a label placed above the line to describe the characteristic of that interface. (Coding should take the form of solid, dotted or dot-dash lines for each type of interface.)

Arrows should be placed on the connecting lines to show the direction of energy flow for an electrical or mechanical interface or the direction of data flow for an informational interface. The point of the arrow should terminate on a block and arrows on both ends of an interface line signify a two way exchange between functional blocks.

The block diagram should be organized so that one can easily find the input(s) to the system and follow the flow through the major functions blocks to the resulting output.

To achieve this facility, the block diagram should be constructed so that the major line of internal flow runs from the top to the bottom of the page or from left to right. One should avoid laying out a block diagram which requires looping back and forth or up and down to follow the flow through the system. This means that the number of blocks should generally not exceed 6–8.

In designing the layout of the block diagram, it may be that 6–8 blocks do not adequately describe the system in the level of detail desired by the PDA. This can be resolved by provided subsidiary block diagrams which are drawn on a functional level which is part of the overall system function. For example, the overall block diagram can have each of its component blocks broken down with a sub-system block diagram for each block. This sub-system block diagram should be constructed following the same rules as the overall block diagram. This process may be repeated as often as desired but it is suggested that a maximum of two levels should be employed even for the most complex system.

At times, it may be possible to eliminate the need for a second level of block diagram by increasing the number of blocks on the overall block diagram to 10 or 12. This practice is perferred since it results in a single page drawing of the system. Foldout pages can be employed with a maximum size of 16 x 10½ (a double page).

Each block on the overall block diagram should be numbered for reference. Blocks on sub-system block diagrams should be numbered with the number of the block of the overall block diagram followed by decimal digits. For example, the overall block diagram may contain a block labeled "Data Link" and numbered 1.0. If a lower functional level drawing is constructed further breaking down "Data Link" each block should be numbered 1.1, 1.2, 1.3, etc., in the sub-system block diagram.

7.1 Overall Block Diagram

The overall block diagram should be constructed in such a manner that a reviewer of the TDP may quickly ascertain the relationship of the system to other systems and the major units of the system under development. In addition to following the general guidelines described in SECTION 7.0, the major flow through the system should be emphasized with a heavy connecting line and arrows between blocks existing in the major flow path.

All associated sub-systems should be illustrated as a single block for each associated subsystem. Appropriate interface lines should be shown. Figure 7-1 illustrates a Typical Overall Block Diagram.

Included in this section should be a general description of the system operation which follows the flow shown on the overall block diagram. This narrative should be quite brief and is employed to provide those reviewers who are not technically oriented with a general picture of the role of this system in relation to overall DOD objectives and programs. This description should refer to specific characteristics of the SOR or ADO.

The blocks appearing in this diagram need not represent physically realizable units or systems but may represent functions which involve both equipments and human actions. This is particularly applicable in non-automated systems where human decision is an integral part of the system operation. The general description of the system operation should include reference to the man-machine interface and critical points of operator information requirements, information flow, decision points, stored information, operator intervention and action alternatives. The overall block diagram should distinguish between equipment operation tasks by phase as given in the general description of the system. An example is a command and control system which may be fully automated in the data acquisition and reaction control functions but may depend upon human intervention to complete the overall action between acquisition and reaction.

7.2 Detailed Block Diagram

This diagram, as stated in SECTION 7.0, is used when further detailing of the system's description is required. There may be detailed block diagrams for some or all of the blocks of the overall block diagram. The degree of detail is a decision to be made by the writer of the TDP and will vary from system to system. General guidelines cannot be established to aid in deciding upon the

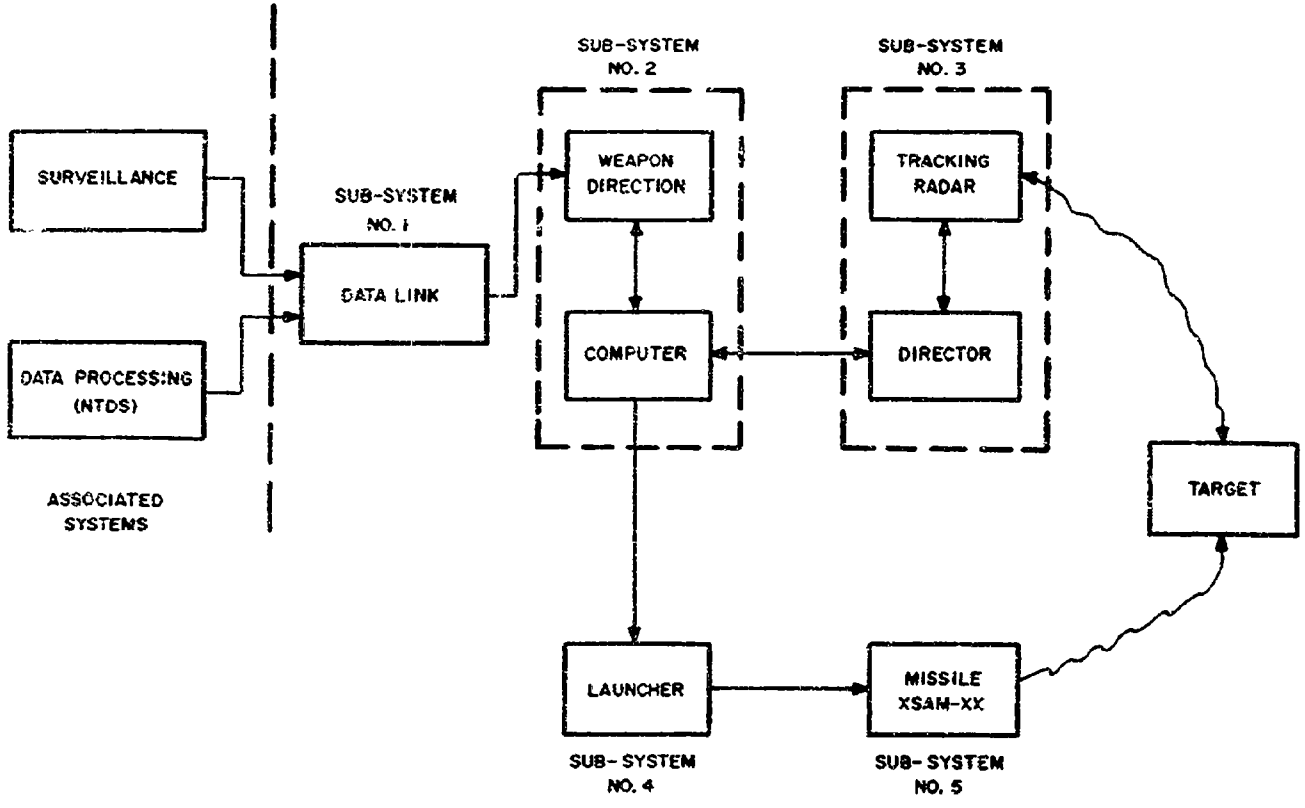


Figure 7-1. Typical Overall Block Diagram XSAM Weapon System.

detail required. However, the detail illustrated in the diagram should relate to the degree of detail employed in SECTION 8, Sub-System Characteristics. That is, for every block appearing in the block diagram, a portion of SECTION 8 shall appear where that block is described.

No descriptive material should be included in this section relating to the detailed block diagram since it will appear in SECTION 8. Figure 7–2 illustrates a Typical Detailed Block Diagram.

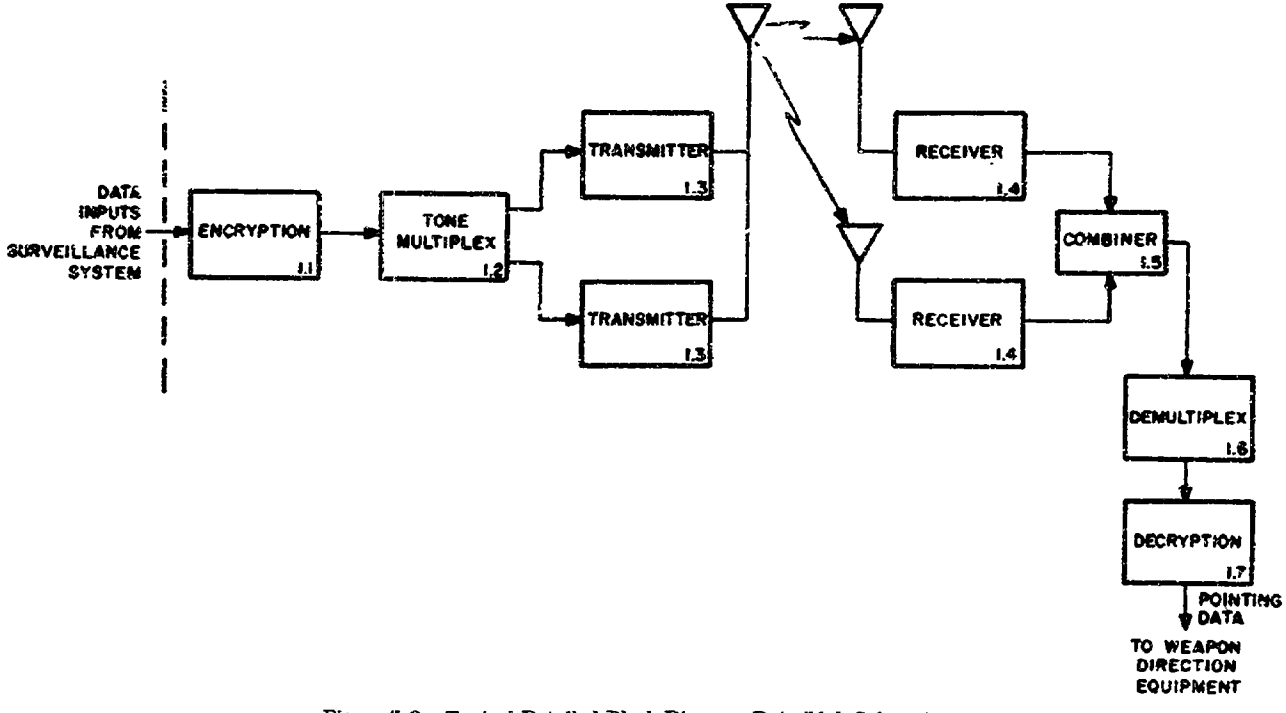


Figure 7–2. Typical Detailed Block Diagram Data Link Sub-system.

TDP Check List

SECTION 7

Block Diagram

1. Can the system be illustrated using 6–8 blocks in overall block diagram?
2. If answer to (1) is "no", have detailed block diagrams been drawn?
3. Have all related blocks been connected by interface lines?
4. Does each block contain its title?
5. Is each block numbered?
   a) on overall block diagram 1.0, 2.0, etc.
   b) on detailed block diagram 1.1, 1.2, etc.
6. Is each type of interface coded and does a legend for the code appear on the block diagram?
7. Are all interface lines labeled with arrows showing direction of flow?
8. Does the major flow through the system exist from top to bottom or left to right?
9. If detailed block diagrams are drawn, can system be illustrated with an overall block diagram of 10–12 blocks?
10. Has the major flow through the overall block diagram been emphasized with heavy lines?
11. Has a brief description of the overall block diagram been included?
12. Have all associated sub-systems and their interfaces with the development system been illustrated?
13. Has each block diagram, overall and detailed, been labeled and numbered?
14. Does the labeling of the blocks in SECTION 7 correlate with SECTIONS 8 and 9?
15. Has the Block Diagram been carefully compared with the Work Breakdown Structure to assure that all key elements of project hardware have been identified?

SECTION 8

Sub-System Characteristics

8.0 General

The purpose of this section is to provide a detailed description of the functional and performance characteristics of each block of the overall and detailed block diagrams as illustrated in SECTION 7. It should also be used to report the current status of each major development including any problam areas that exist or that can potentially occur.

8.1 Detailed Characteristics and Description

Each block of the block diagram(s) should be referred to in numerical order and a detailed description provided. The description should contain the following elements:

1. A brief lead sentence summarizing the overall function of that block.
2. A flow-oriented description starting with inputs and following the flow through to the outputs. As each input or output interfacing with another block or associated sub-system is described, the interfacing element should be referred to by section and paragraph number. Permissible tolerances on all characteristics should be stated if these tolerances have been defined.

Following this descriptive material should appear a tabulation of the critical characteristics of the block being described. Particular emphasis should be placed upon clearly defining and relating those parameters which have evolved as a result of specific goals called out in the SOR or ADO. The critical characteristics should include specific definition of the interface parameters between this sub-system (block) and any other sub-system (block).

At times, certain critical parameters would require advanced development to resolve. Where the parameter can be quantitatively defined, it should be, and a statement made regarding the necessity for advanced development. A complete description of the plan to determine the solutions to these problem areas should also be described. Where potentially difficult technical problems exist between units of the system, the technical trade-offs in performance should be described if the specified parameter cannot be achieved. If a problem area exists involving the achievement of a difficult technical goal to which a forthright plan of attack cannot be resolved at the time of writing, attention should be called to this problem. Although a specific plan may not exist, other researches may be under way which could provide pertinent inputs. These programs should be described and the potentialities of applying their results should be pointed out.

Any special characteristics of the design should be stated. These include special construction techniques employed or high reliability or maintainability goals, which although within the state-of-the-art, are somewhat unique. Other

characteristics which should be stressed are adaptability to the solution of other problems, long life, lack of requirement for special operator or maintenance personnel training, and ability to meet current spare parts stocking. Emphasis should be placed upon the standardization of parts to MIL-STD-242 if such is a requirement of the design.

The section should conclude with a summary of the current status of the development. Status should be reported in terms such as "specification only," "on the shelf," "in development," etc. Where specific contractors and/or governmental agencies are charged with a particular development responsibility, the responsible party should be named. (See Responsibility Matrix, Section 5). Included in this status report should be an estimate of the technical risk involved in achieving the critical technical goals of each development task. This estimate should be made in the form of a probability estimate, e.g. 95% probability of meeting goals, 80% probability, etc. Each probability estimate should indicate its associated statistical confidence factor.

8.2 Human Engineering

This section should be devoted to describing the human engineering which has been or will be applied to each development described in Section 8.1. Characteristics of sub-systems which affect, or are affected, by human resources must be clearly defined. This should include any special requirements including manpower utilization, skill levels, training and safety. These characteristics should be coordinated with SECTION 13, Personnel and Training Plan.

Those developments which result in equipment involving man-machine interfaces in both the operating and maintenance areas should be defined. Definitive plans for insuring the proper application and implementation of sound human engineering principles should be specified.

Where the ultimate operating environment of any equipment imposes certain limitations upon normal human action, attention must be paid to overcoming the deleterious environment. For example, if equipment may operate in a possibly toxic atmosphere, adequate plans must be described to safeguard the operator of such equipment.

In addition, general layouts of operating spaces should be described and diagrams of such layouts included. The plans for providing adequate lighting, heat, air-conditioning, etc., must be indicated. Installation plans describing who will do the planning and who will be assigned actual installation responsibilities should be included as part of this section.

Where equipments will be continually manned, such as operator consoles, sketches of equipment arrangements in the console along with the location of key operating controls should be included. For comparison purposes, a drawing of a man should be shown next to the console.

SECTION 8

Sub-System Characteristics

1. Has a portion of this section been allotted to describing each block of the overall and detailed block diagram?
2. Does the description adequately define the functions of that block?
3. Are interfaces with other blocks pointed out and quantitatively defined with permissible tolerances?
4. Have all critical performance characteristics of each block been tabulated and reference made to SOR or ADO goals where applicable?
5. Have those characteristics requiring advanced development been identified and a plan included for achieving this developmental goal?
6. Have problem areas to which no immediate solution is evident been identified?
7. Have the special features of the design been enumerated?
8. Has a summary of current status been included along with an estimate of probability of achieving the technical goal?
9. Has a section been devoted to the human engineering factors imposed upon the equipment and the operating environs of the equipment?
10. Have all participating contractors and/or government agencies been identified and their responsibilities defined?

SECTION 9

Associated System Characteristics

9.0 General

In SECTION 7, the required block diagram of the system was discussed which illustrates the functional relationship between the developmental system and other systems. These other systems, which interface with the developmental system, are termed associated systems.

It is the purpose of this section to completely define the interfaces and other possible interdependencies between the developmental system and associated systems. Where concise definition of the interface is not possible, plans should be described for resolution of the problem areas.

The associated systems should be listed at this point together with a reference to the particular sub-system of the developmental system with which they interface. Later, the detailed characteristics of the interfaces with these associated sub-systems will be defined. The current status of these associated systems in relation to whether they are operational or developmental should be indicated on this summary listing. The cognizant agency for each associated sub-systems should also be included in the table.

The role of the associated sub-systems in regard to aiding the developmental system in meeting its SOR or ADO goals should be described. This description should only extend to the relationship between the developmental system and its associated system. Other characteristics of the associated system not specifically related to the developmental system should not be defined or described. The associated systems can be generally grouped into two categories: Physically associated systems and functionally associated systems.

9.1 Physically Associated Systems

These systems are those which have electrical interfaces with the developmental system. They will interface with one or more of the sub-systems defined in SECTION 8.

In this section, the detailed characteristics of the interface(s) shall be described. The degree of detail employed shall be adequate to assure the reviewer that a compatible interface will exist. If the interface is with an organization over which the PDA does not have control, e.g., other services, the technique for controlling this interface shall be described.

A particular example is where the developmental system could have an interface with a Defense Communications Agency circuit. The required number of circuits, their capacity and the detailed electrical interface should be specified. Also, a plan shall be described to coordinate the satisfactory compliance with the interface definition. Any working groups established to coordinate this type of activity should be mentioned.

Consider and describe whether or not significant changes to existing ships or other facilities will result from successful system development.

Also, indicate what changes in maneuvering characteristics, safety provisions (including notably the water-tight integrity of submarines), vulnerability to explosive shock or weather, etc. may be entailed if the system is utilized in the Fleet.

If a particular interface has not been resolved at the time of writing of the TDP, a plan shall be outlined to resolve the problem. At times, this may involve field measurements or laboratory investigation. If this is the case, the contributing agencies, both industrial and government, shall be named and their specific responsibilities shall be defined.

For those electronic interfaces which can be defined, the specific sub-system of SECTION 8 with which the associated sub-system interfaces, shall be defined. The interface shall be completely and quantitatively specified including tolerances on all values. In additon, if any mechanical interfaces exist, the characteristics of these interfaces shall be defined and shall include tolerances.

As in SECTION 8, a tabulation of these critical interface characteristics should be included for convenience of reference. This will enable any interested party to quickly assess the contribution of other systems to the operational performance of the developmental system. A sample format for summarizing the characteristics of each interface is included as Appendix F.

In this section, any plans for test and evaluation to ensure interface compatibility shall be referenced. These plans should be described in detail in SECTION 12, but the particular interface to be tested shall be introduced herein in regard to its relationship to the developmental system.

9.2 Functionally Associated Systems

These systems are those which do not have direct mechanical or electrical interfaces with the developmental system but which either supply inputs to, or take outputs from, the developmental system.

These systems may either interface with the operational mode of the developmental system or in the support mode.

Examples of these are the following:

(a) A logistic system which supplies support material for the operational system. The developmental system may be intended to operate in a geographical area requiring special facilities to enable supply to be achieved.

(b) An associated system which either supplies input information to, or uses data outputs, of the developmental system.

(c) An existing maintenance system which will be employed during the operation of the developmental system.

The interfaces between this type of associated system and the developmental system should be defined in as quantitative a manner as possible. Often, this type of interface does not lend itself to exact definition in the quantitative sense; however, the interface should be defined if in only a functional manner.

As in the case of physically associated systems, any interface requirement which has not been met should be pointed out. A plan for resolving the problem should be promulgated to assure the reviewer that adequate management attention is being directed towards the solution of the problem.

Although personnel are not identified as a separate entity, the man and his functions can be treated as having unique interface effects on associated systems because of potential problems in interface control and synthesis. Efforts should be made toward defining operator relationships by a review of data available from SECTIONS 7 and 8.

9.3 Summary

The adequate resolution of interface problems can often be a major problem to the PDA. This is especially true in controlling interfaces with associated systems over which the PDA does not have cognizance. To insure compatibility, a design interface specification should be written and signed by all parties who may institute interface changes. A program to control each interface should be described and an individual or group of individuals should be assigned responsibility for this control.

This area, of interface definition and control, is a potential source of added expenditures requiring backfitting, field modifications or major design changes. This section of the TDP should define an adequate program for interface control to minimize the potentially costly effect of an interface change which was made without the knowledge and consent of all interested parties.

TDP Check List

SECTION 9

Associated Sub-Systems

1. Has the role of all associated sub-systems been summarized in a reference table?
2. Have the detailed interface characteristics of all associated systems been described? Have tolerances been included? (See Appendix F for sample format.)
3. Has an Interface Control Group been established and its responsibilities defined in the TDP?
4. Have plans been described to resolve interface problems?
5. Has the portion of the developmental system having external interfaces been identified?
6. Are the details of each interface included in a tabulation?
7. Has the Test and Evaluation section been referenced in regard to its impact upon the testing of interfaces with associated sub-systems?
8. Have all functionally associated systems been listed with concise definitions of the interfaces with the development system?
9. Has funding support been established for interface engineering, design, test and support?

SECTION 10

Reliability and Maintainability Plan

10.0 General

The purpose of this section is to outline a plan for assuring that the system being developed is capable of meeting stated reliability and maintainability objectives. Reliability and maintainability are two major factors contributing to System Effectiveness. (Table 10–1 illustrates the elements in an overall plan.) These objectives should be defined quantitatively herein and should be based upon the Operational Readiness goals as stated in the SOR. The objectives should be examined carefully for feasibility of achievement.

This section should carry as much emphasis as any other section in the TDP as reliability and maintainability are, in fact, performance parameters of the system. Since every element of the system, both man and machine, contributes to the overall reliability and maintainability, a program of definition, design, prediction, monitoring, and evaluation must be included to minimize any possibility of producing a technically acceptable but operationally unacceptable system.

If the TDP is in response to an ADO, the reliability and maintainability objectives do not need to be defined if the system being developed in response to the ADO is not to be a prototype model. Nevertheless, a plan should be described to provide some degree of reliability assurance during the research phase. This plan need not be definitive in the quantitative sense but should describe a program which makes both reliability and maintainability factors to be considered in the experimental development program. A minimum requirement is a clear statement of the reliability and maintainability philosophies to be followed.

TABLE 10–1. Elements in Reliability and Maintainability Plan

Reliability
Feasibility Analysis for Parameter Values in SOR/ADO
Mission Profile
Reliability Goals
Reliability Modeling
Reliability Apportionment
Reliability Predictions
Reliability Measurements
Component Part Reliability
    Environmental Effects
    Storage Considerations

Maintainability
Feasibility Analysis for Parameter Values in SOR/ADO
Maintainability Goals
Maintainability Modeling
Allocation of Repair Responsibilities
Predictions
Measurements
Repairability Status
Repair Techniques

NOTE: These elements apply to man segments of the system as well as to machine segments.

Therefore, this section should define plans for both reliability and maintainability assurance. Each plan should indicate the steps to be followed, the general techniques or specifications to be applied, the major milestones in the program and the responsible parties charged with establishment of goals and monitoring of progress toward these goals. The plan should include a reporting method to be imposed upon contractors in support of the plan. The quantitative objectives for reliability and maintainability for each sub-system should be stated as well as the overall system performance in all of its operating modes. It is recognized that quantitative objectives may not be available for some systems under advanced development, for those systems assumed quantitative objectives should be provided.

The overall availability of the final system is a function of its quantitative reliability expressed as Mean Time Between Failure (MTBF), and its quantitative maintainability expressed as Mean Time To Repair (MTTR). Because of this relationship and because of the ultimate interest of the operating forces in System availability, the PDA should define plans for reliability and maintainability assurance which complement each other in such a manner as to insure the achievement of the overall availability objective.

10.1 Reliability Assurance

10.1.1 Reliability Plan

Figure 10-1 illustrates the major phases of a reliability program. In the detailed reliability plan the Project Manager must describe the procedures and techniques to be employed during each phase of the reliability program.

Furthermore, one must make certain decisions which will be reflected in the TDP in regard to which phases of the reliability program may be downgraded and which may be emphasized in the particular reliability plan being applied to the system.

Prior to establishment of a detailed reliability plan, the PDA must answer the following question: "Is reliability prediction an adequate technique for assurance of reliability or will a reliability demonstration be required?" The answer to this question will establish the overall philosophy of the reliability plan and a number of important factors should be weighed when considering the question.

To evaluate these factors, it is best to examine a typical reliability plan as illustrated in Figure 10-2. The figure illustrates major events occurring in

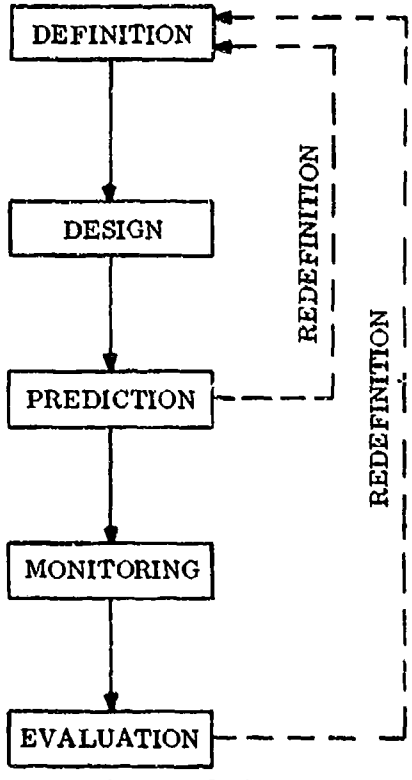


Figure 10-1. Phases of a Typical Reliability Program.

the course of the plan and the following sections explain the events in more detail.

Figure 10-2 presents an outline for a plan which can act as a basis for most reliability plans. The degree of emphasis placed upon any event must be evaluated in light of each program by the PDA. The events, however, are the same and fit within the overall framework of any reliability program; i.e., definition, design, prediction, monitoring and evaluation.

10.1.2 Establishment of Overall Reliability Goals

It is the responsibility of the Project Engineer to determine the reliability goals for the various operating modes of the system in response to the Availability and Operational Readiness goals established in the SOR. (A useful reference guide in assisting Project Engineers in this task is NAVWEPS 00-65-502 Reliability Handbook, 1 June 1964. This document describes the various factors to be considered and the mathematical techniques to be employed in establishing the overall MTBF for the system.)

10.1.3 Determination of System Configuration

In response to the technical and operational requirements of the SOR, a system configuration is determined. This configuration is illustrated in block dia-

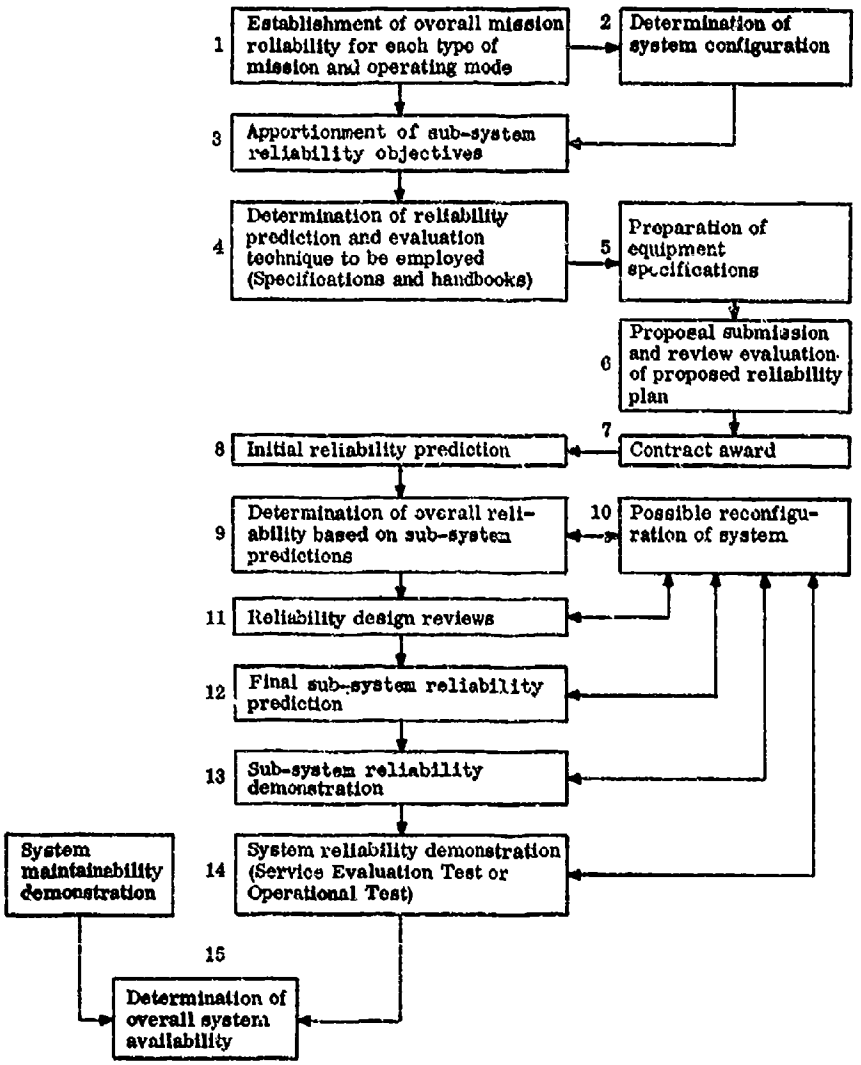


Figure 10-2. Events in a Reliability Plan.

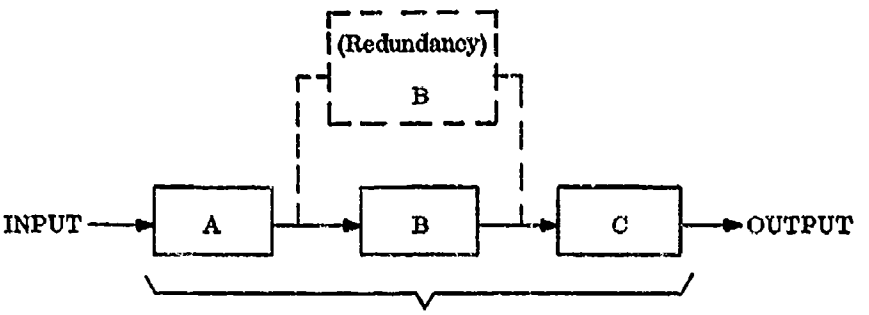
gram form in SECTION 7 of the TDP. From this overall block diagram, the Project Engineer will devise functional or model diagrams which will illustrate the system in its various operating modes.

10.1.4 Apportionment of Sub-System Reliability Objectives

The overall system reliability goals are applied to the various functional models of the system and sub-system and unit MTBF's or other measures (i.e., cycles, etc.) of success are arrived at by the Project Engineer. These objectives are determined by considering relative complexity of each unit or sub-

system and the state-of-the-art for that particular type of device. At this time the Project Engineer may consider the use of redundancy either in circuits, units or sub-systems if his experience indicates that state-of-the-art limitations dictate a need for such redundancy in order to achieve the system reliability goal.

Figure 10-3 illustrates a technique of reliability apportionment. As an example of the application of this technique, assume that a system consists of sub-systems A, B and C which function as shown in Figure 10-3 and that the overall, P_s, mission reliability for the system for a 10-hour mission is 0.95. (The mission duration and reliability goal are established in the SOR.)



$P_S = .95$

	MTBF Objective for a 10-Hour Mission
$P_A = 0.99$	1000 hours
$P_B = 0.98$	500 hours
$P_C = ?\ (.979)^*$	476 hours
$P_S = .95$	196 hours

* P_C is the quantity to be determined

Figure 10-3. Apportionment of Reliability Goals.

This P_S is the product of the probability of survival of each sub-system. If P_A is the probability of survival objective for system A, and P_B is the probability of survival for system B, etc., then P_S can be expressed as

$$P_S = P_A \times P_B \times P_C$$

Based upon experience and state-of-the-art, assume that P_A can be set at 0.99 and P_B at 0.98. The determination of the reliability goal for system C, P_C, can be found from

$$P_C = \frac{P_S}{P_A \times P_B}$$

Using the figures from above

$$P_C = \frac{P_S}{P_A \times P_B} = \frac{.95}{.99 \times .98} = \frac{.95}{.97} \approx .979$$

Now the MTBF for each sub-system is related to the probability of survival and the mission duration by the relationship*

$$P_S = \epsilon^{-\lambda t}, \ \lambda = -\frac{\ln P_S}{t} \qquad \text{(See Appendix D for Reliability Nomograph)}$$

where P_S = probability of survival
ϵ = base of natural logarithms, 2.718
$\lambda = \frac{1}{\text{MTBF in hours}}$
t = mission duration in hours

By substituting the allotted P_A and P_B, and the computed P_C in this equation, the MTBF goal for each sub-system may be arrived at, yielding

MTBF_A = 1,000 hours
MTBF_B = 500 hours
MTBF_C = 476 hours

These figures will be used as a design parameter in the specification of each sub-system.

If, as the development progresses, the expected P_S of system B is determined to be 0.97 rather than 0.98, a reapportionment of reliability objectives will take place.

Either P_A or P_C or both could be increased to accommodate the deficiency in the performance of system B or as an additional alternative, system B can be made redundant as illustrated in Figure 10-3. The choice of alternative must be made considering the relative cost of each.

If, for example, the choice is made to increase the reliability objective for system C, the following apportionment will result:

Probability of Survival	MTBF Objective for a 10-Hour Mission
P_B=.97 (revised)	333 hours
P_A=.99 (unchanged)	1,000 hours
P_C=? (.989) revised	910 hours
P_S=.95 (unchanged)	196 hours

*An exponential relationship is assumed to apply. Specific cases may require other distributions.

10.1.5 Determination of Applicable Reliability Prediction and Evaluation Techniques

It is at this point that the PDP must decide the answer to the question previously posed; "Is reliability prediction without evaluation adequate?"

A program of reliability demonstration of necessity will involve increased program cost and possibly a lengthy testing period. To measure the MTBF of a sub-system or unit with high confidence, the sub-system must be operated for long periods with enough failures occurring to provide a large enough statistical sample to determine the mean operating time.[1] As an alternative to this, many sub-systems or units may be built and operated concurrently, thus cutting down the overall time to collect reliability data. But the latter alternative involves the increased cost of construction of additional equipments.

If reliability prediction is felt to be adequate, then an extensive testing period or the time and cost of constructing additional equipments are avoided. However, an uncertainty will exist concerning the ability of the final system to meet the required reliability goals.

Depending upon the value of the predicted MTBF relative to the required MTBF and the confidence in the basic reliability data and techniques employed in the prediction, the level of uncertainty will vary. Certainly, a predicted mean life exceeding the requirement by 50 percent or greater would influence the PDA towards reducing the reliability testing if one is considering such a course of action. On the other hand, a prediction close to the requirement may prove influential towards the opposite decision.

This then is the decision to be made by the PDA. One must assess the cost/time vs. confidence level tradeoff to determine the type of reliability plan to be implemented.

To make this decision the Project Engineer should provide the PDA with the basic data concerning number of units required for a reliability demonstration, expected test periods, and anticipated confidence levels.

If the PDA decides that reliability prediction is adequate for his needs, he should discuss the factors influencing this judgment and his assessment of their cost effectiveness in this section of the TDP. Any other factors, such as urgency in obtaining equipment, which might influence such a decision should be explained as well.

Once this decision on basic philosophy has been made, the PDA should indicate which documents will be invoked in implementing the reliability plan. For example, he must decide if he will require contractors to provide predictions according to MIL-STD-756 (The DOD Standard), or if he will permit contractors to submit their predictions based upon other military or commercial standards. The method of reporting of contractor predictions and evaluations must be established and a failure reporting program should be imposed upon

[1] As an indication of the amount of testing involved, let us assume that one wishes to measure the MTBF of a system with a confidence level of 90%. If tests are run until 30 failures occur and if the measured MTBF after 30 failures is 100 hours, one can be 90% confident that the actual MTBF is between 76 and 139 hours. For higher levels of confidence or to decrease the expected range of the mean, more failures must be experienced hence longer testing periods or increased equipment quantities are required.

the contractor which requires him to report and analyze the cause of all failures occurring during equipment development. Rather than establishing a reliability plan for the contractor, the PDA may elect to require the contractor to submit his proposed reliability plan to the PDA for approval. The TDP should indicate which course of action will be chosen. If this course of action is chosen a schedule for submission, review and approval of the contractor's plan should be established.

Figure 10-4 is a chart summarizing most of the military specifications and standards available to the PDA as supporting documentation. By familiarizing himself with the documents defining reliability program requirements and those defining reliability techniques to be employed in design, development and production, the PDA should be able to invoke an existing specification which will closely meet his particular program needs. MIL-STD-785 Reliability-General Specification should be reviewed for applicability to most programs.

10.1.6 Preparation of Equipment Specification

After establishing the general philosophy of the reliability plan and determining the applicable documents, a section invoking these documents and procedures is included in the equipment specification.

The required MTBF should be included in the section of the specification defining performance parameters but the methods to be employed in prediction and evaluation as well as any special requirements on contractor monitoring, review and reporting should be included under quality assurance provisions. The specification also should detail the environmental, reliability and other tests which will be performed on the equipment. The Design Specs listed in Figure 10-4 include as a rule environmental requirements which should be considered for the particular type of equipment under consideration. Careful consideration should be given to the expected shipping, storage and operating environment of the equipment so that the environmental tests which are invoked are compatible with the conditions of the actual environment.

A method of failure reporting and analysis should be invoked within the specification to assure the PDA that the contractor is continually applying a program of quality assurance to his design.

10.1.7 Proposal Submission and Review

The next step in any reliability plan is the review of contractor proposals. As an aid in evaluating the contractor's submission of his reliability programs, the PDA should refer to Figure 8-3, Pages 8-11 and 8-12 of NAVWEPS 00-65-502 Reliability Handbook which offers a convenient checklist.

This chart indicates the major points of interest to the Project Engineer when evaluating proposals and determining the responsiveness of proposals.

10.1.8 Contract Award

Included in the contractual documentation should appear the requirement to follow a reliability plan as agreed upon during contract negotiation. The requirement may appear as an applicable document or reliability plan in the specification or it may appear as a separate contract item where deliverable reports are required.

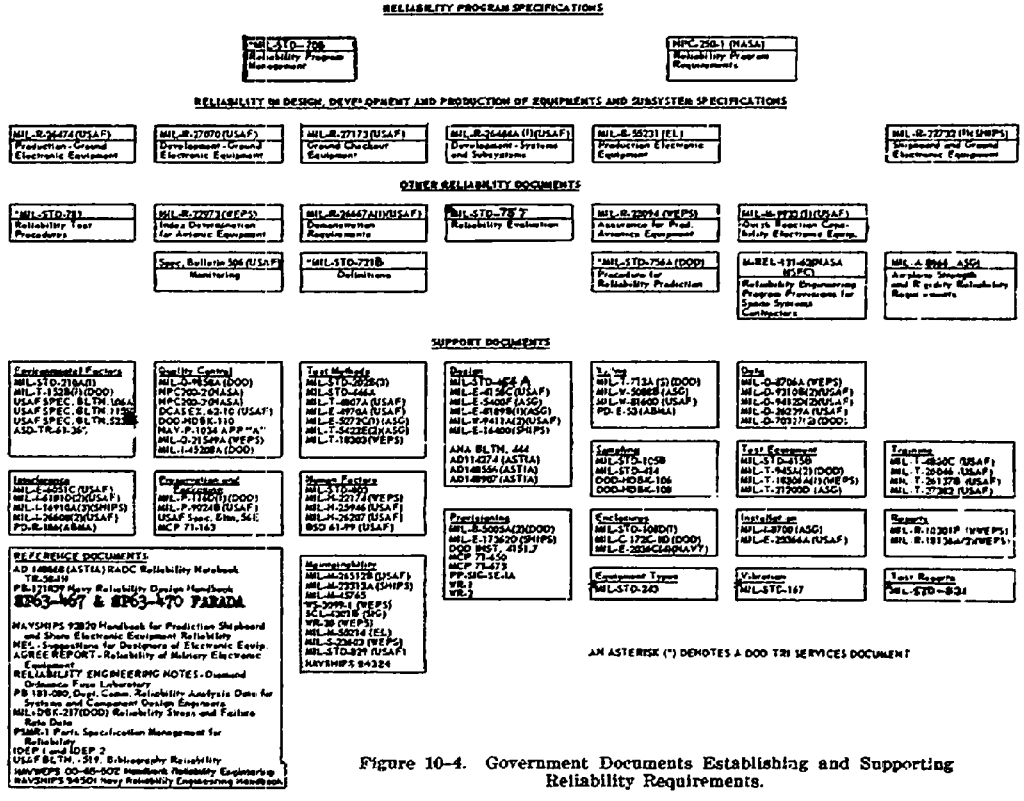


Figure 10–4. Government Documents Establishing and Supporting Reliability Requirements.

10.1.9 Initial Reliability Prediction

Each contractor shall be required to submit for PDA approval, an initial estimate of sub-system reliability immediately upon his completion of the paper design of his equipment. The submission shall be in sufficient detail as to permit the PDA to evaluate the validity of his prediction technique, its application and its results. MIL-STD-756, should be reviewed by the PDA for applicability in this phase of the program.

10.1.10 System Reliability Prediction

After evaluating each contractor's submission, the PDA will use these predictions to estimate the reliability of the system in its various operating modes. Comparisons will be made between the predicted reliability in each mode and the reliability goals which were described in Section 10.1.1 herein.

10.1.11 Possible Reconfiguration of System

As a result of the comparison between predicted system reliability and the reliability goals, it may be necessary to consider a reconfiguration of the system. If the goal exceeds the prediction, one may consider the use of redundancy of units or sub-systems or a redesign of equipment as means toward increasing the overall predicted reliability. Another possible alternative is a review of the goals to reduce them to meet the prediction. This alternative should be considered in light of the potential increased cost in providing redundancy or improving the equipment design to enable the system to meet its initial reliability objective.

The prediction should always exceed the goal. If the prediction exceeds the goal by a margin of over 2 to 1, a potential over-design situation exists. This conclusion is dependent upon the confidence level placed in the prediction. This confidence level must be based upon actual prior measurements on other projects which employed the same basic failure rate data and prediction techniques. Such a review of previous results should provide the Project Manager with an indication of the confidence he may place in the prediction. For example, a compilation of actual vs predicted MTBF's may indicate that the prediction is generally about 75% of the measured MTBF. If this factor, applied to the prediction, still results in a weighted prediction substantially exceeding the goal, the basic design should be reviewed to determine if any modification can be made which, although it reduces the predicted MTBF, may also reduce the cost. Do not reduce the MTBF by design changes unless cost or other benefits are evident. At this point a cost/effectiveness study should be performed to provide the basic tradeoff data upon which such a decision may be made.

The review and updating of system configuration should be a process which is employed after completing significant events in any phase of a project. It should occur during a reliability program whenever predictions or measurements result in overall system performance which is not in accord with system reliability goals.

10.1.12 Reliability Design Reviews

As the design of the equipment progresses, each contractor should be required to perform at least one critical reliability design review before freezing

the design. Any changes in equipment configuration or major component complement should be appraised and a new reliability prediction should be produced The critical items of appraisal to be considered during such a review are described in Paragraph 3.2.2.6 of MIL-R-22732B (SHIPS).

As a result of this review, it may be necessary to reconsider the system configuration as described in Section 10.1.10 herein. The PDA should carefully monitor and evaluate the predictions and failure reports from all contractors. Since these predictions will, in general, not be available concurrently, the PDA should carefully weigh the impact of each contractor's prediction upon the reliability goals established by specification for each other contractor.

10.1.13 Final Sub-System Reliability Prediction

When all design changes have been incorporated into the equipment and a final configuration exists, the contractor should perform a final reliability prediction. This prediction should be appraised for its effect upon overall system reliability, as are all predictions.

If required, the system configuration should be reviewed for possible modification.

10.1.14 Sub-System Reliability Demonstration

When a program of reliability demonstration is to be undertaken, both under development and/or production contracts, the resulting data should be evaluated in light of the reliability objectives.

At this point confidence levels in the measured MTBF can be quantitatively determined. (For details of this technique see NAVWEPS 00-65-502 Reliability Handbook-Appendix 3.)

A final computation may now be performed, using actual data on sub-system reliability, to predict system reliability. Again, a review of system configuration based upon a comparison of goals and extrapolated measurements should be made.

As each succeeding prediction and appraisal is performed during the reliability program, the impact of each of these upon system configuration should diminish. It is to be expected that major changes in configuration may occur as a result of the earlier predictions but the evaluation of the effect of the reliability demonstration on overall reliability should result in little if any alteration to the system.

A number of techniques of reliability demonstration are available for use during this phase of the program. MIL-STD-781, "Test Levels and Accept/Reject Criteria for Reliability of Non-Expendable Electronic Equipment," outlines a series of environmental test levels which can be employed for the purpose of reliability demonstration NAVWEPS 00-65-502, "Reliability Testing," Sections 6 and 7, provide useful data for the design of tests for reliability demonstration.

10.1.15 System Reliability Demonstration

This phase measures the validity of all assumptions, predictions and analysis techniques previously employed.

In the case of a developmental equipment, tests and evaluations, as described in SECTION 12 of the TDP, are the vehicles through which system reliability is

demonstrated. In the case of production equipments, the final in-service operation provides the means for measuring system reliability. Regardless of how closely conditions are simulated, and performance tests are planned, it is operation under actual service conditions which provides the technique for full evaluation. It is here that the maintenance procedures and operating procedures are employed to stress the equipment with factors not existing in a laboratory or factory.

Failure reports and equipment logs should be prepared in accordance with MIL-E-16400E, Amendment 4, Paragraph 3.1.8, General Specification, Electronic Equipment, Naval Ship and Shore.

These reports provide a means for measuring system reliability with high confidence and assist in the determination of the "true" MTBF.

10.1.16 Determination of Overall System Reliability

After the "true" reliability and "true" maintainability of the system have been determined as described in part in Section 10.1.15, the system availablity may be determined from the following formula:

$$\text{Availability} = \frac{\text{MTBF}}{\text{MTBF} + \text{MTTR}} \times 100\%$$

(See Appendix C for Availability Nomograph)

where MTBF (Mean-Time Between Failures) is the mean operating time and MTTR (Mean-Time to Repair) is the mean down time, for each operational mode of the system.

This is the final step in the reliability plan.

10.2 Maintainability Assurance

10.2.1 Maintainability Plan

The Events in a Maintainability Plan outlined in Figure 10-5 can be used as a basis for most maintainability plans. As in the Reliability Plan, the PDA must describe the procedures and techniques that will be employed during each phase of the project and the degree of emphasis to be placed on each event. The major events of a typical maintainability plan are described in the following paragraphs to guide the PDA in making maintainability decisions which will be reflected in the TDP.

10.2.2 Establishment of Maintainability Goals

It is the responsibility of the Project Engineer to determine the system quantitative maintainability goal within the framework of the operational and planning information outlined in the SOR. A suitable reference guide for this task is NAVSHIPS 94324, "Maintainability Design Criteria Handbook for Designers of Shipboard Electronic Equipment." This document describes the various factors affecting maintainability and the mathematical techniques to be employed in establishing system MTTR values.

10.2.3 Maintenance Philosophy

In addition to providing essential data for the Supportability Plan, and the Personnel and Training Plan, the maintenance philosophy provides useful information for predicting maximum and minimum requirements for MTTR

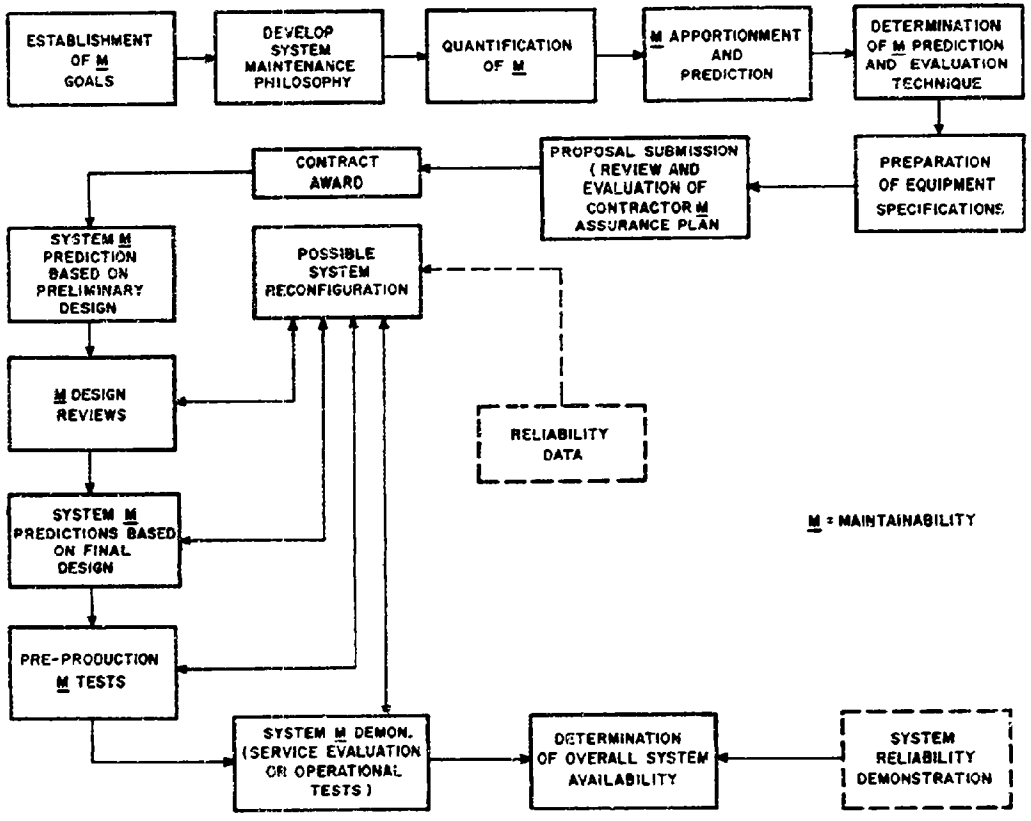


Figure 10-5. Events in a Maintainability Plan.

and for the allocation of the overall system maintainability measures to various functional levels. The responsibility for developing the system maintenance philosophy is assigned to the Project Engineer. Useful information on the relationship of elements in the maintenance cycle to maintainability design can be found in NAVSHIPS 94324.

10.2.4 Qualification of Maintainability

Development of numerical measures of maintainability for inclusion in the TDP can be accomplished by predictive methods based on information provided by the system maintenance philosophy. Typical prediction methods and expected ranges of MTTR for various repair methods can be found in the maintainability evaluation procedures of MIL-M-23313A(SHIPS) or MIL-S-23603.

Since system availability (A) is a function of both MTBF and MTTR,

$$(A=\frac{MTBF}{MTBF+MTTR}),$$

maximum and minimum values for MTTR should be stated whenever fixed values are not specified. This will afford some degree of tradeoff between reliability and maintainability design for a specified value of A. Information regarding MTBF-MTTR tradeoff possibilities is contained in NAVSHIPS 94324.

10.2.5 Maintainability Apportionment

The allocation overall system measure of maintainability to lower order elements of the system can be accomplished by prediction methods described in MIL-M-23313(SHIPS), or MIL-S-23603. General information requirements and the mathematical techniques for determining maintenance task times related to each functional level of the system are provided in this document.

10.2.6 Determination of Maintainability Prediction and Evaluation Technique

At this point, factors which will influence the PDA decisions regarding reliability prediction and evaluation will also affect decisions concerning maintainability prediction and evaluation. The alternate approaches to maintainability assurance which will be possible once the basic philosophy decision has been made, parallel those described (see Section 10.1.4) for implementing the reliability plan. Some of the maintainability documents which may be invoked are listed in Figure 10-4.

10.2.7 Preparation of Equipment Specifications

All maintainability documents and procedures to be invoked must be included in the equipment specification. In defining performance parameters in the specification, the required measures of MTTR should be included and the quality assurance provisions should include prediction, evaluation, monitoring, review and reporting methods and requirements. Maintainability specifications must give due consideration to human factors which affect system performance. Contractors should be cautioned to incorporate human resource constraints in their design for maintainability. The specifications for maintainability requirements contained in MIL-M-23313A(SHIPS) are typical.

10.2.8 Proposal Submission and Review

The maintainability program submitted by the contractor should be reviewed jointly by the Project Manager and the Project Engineer to determine responsiveness to specifications.

10.2.9 Contract Award

Maintainability requirements should be included in the contractual documentation in the manner described for reliability requirements (see Section 10.1.7).

10.2.10 System Maintainability Predictions and Design Reviews

Initial maintainability predictions submitted by the contractor(s) during the design planning stage of the system research and development phase are used by the PDA for early estimates of overall system maintainability. Methods and schedules of evaluation to be used during the early design stages are usually left to the contractor providing compliance with specifications in the final design is assured. Maintainability design reviews, whether independent or integrated with reviews for other purposes, provide the means for implementing maintainability design control necessary to assure (1) meeting the specific human factors criteria for the equipment or system in compliance with contract requirements, and (2) changes affecting maintainability design are handled expeditiously. The final maintainability prediction(s) by contractor(s) should be analyzed and the overall system maintainability prediction to determine if the specified requirements will be met. System reconfiguration that might occur will require a continuing effort of maintainability throughout the preproduction and service evaluation test stages. Techniques and conformance/nonconformance criteria are provided in maintainability specifications listed in Figure 10-4. MIL-M-23313A(SHIPS) is typical of those imposed throughout system development and production programs.

10.2.11 Scheduled Maintenance Considerations

This section has appropriately emphasized the unscheduled aspects of maintenance. Since all maintenance requirements must be considered in the Maintainability Plan, the Project Engineer is enjoined to include in his considerations, scheduled maintenance aspects such as:

(1) Cycling or turn-around time requirements.
(2) Provisions for concurrent servicing of the various subsystems.
(3) System reaction time requirements.
(4) Troubleshooting and fault diagnostic methods desired.
(5) The system maintenance concept and what it should include (levels of maintenance and associated maintenance tasks and functions).
(6) Periodic (scheduled) maintenance requirements, including calendar time or operational limitations governing inspection and rework of the system.
(7) Maintenance manhour requirements or objectives per operating hour, per flight hour, or other measure of time or events.
(8) Maintenance and operating factors for personnel requirements determinations.
(9) The required or desired degree of system readiness (availability).

(10) Times required for fault identification, isolation, correction and repair verification.
(11) Maintainability verification schedules and methods used during development effort.
(12) Types of missions, mission duration and frequency, or modes of operation, duration and frequency.

10.2.12 System Maintainability Demonstration

The validity of all maintainability assumptions, predictions, and analysis techniques for developmental equipment is measured during the planned tests and evaluations of SECTION 12. Data devised from the system maintainability and reliability demonstrations are used to determine the overall system availability as described in Section 10.1.15.

TDP Check List

SECTION 10

Reliability and Maintainability Plan

1. Is the TDP in response to an ADO?
2. If "yes", does the TDP impose some requirement for reliability assurance during research?
3. If the TDP is in response to an SOR, has a detailed reliability plan been described?
4. Has the question of reliability prediction vs. reliability demonstration been considered?
5. Have reliability goals been established for each mode of system operation using the SOR goals as a basis?
6. Have reliability objectives been established for each sub-system of the development and are these objectives quantitatively defined in terms of MTBF?
7. Has a specific reliability prediction and evaluation technique been selected from those available as illustrated in Figure 10-4?
8. Has the type of reliability program selected by the Project Manager been justified in the TDP?
9. Has the intended operational environment been considered when selecting types of reliability demonstration tests?
10. Has a complete plan been described covering the definition, design, prediction, monitoring and evaluation of reliability performance?
11. Has a thorough cost/effectiveness analysis been performed using the SOR availability goals as a basis?
12. Have quantitative maintainability requirements been stated?
13. Have maintainability objectives for each stage of system development been stated?
14. Has responsibility for implementing each part of the maintainability plan been assigned?
15. Does the maintainability plan establish a schedule whereby all maintainability efforts are reviewed and evaluated by the responsible activity?
16. Is the maintainability plan flexible enough to allow for modifications and improvements based on updated information?
17. Will implementation of the maintainability plan assure early prediction and ultimate formulation of a realistic and workable maintenance program which is in accordance with stipulations of the SOR?
18. Have human factors considerations been made integral to the design for maintainability?

SECTION 11

Operability and Supportability Plan

11.0 General

The purpose of this section is to assure that adequate consideration has been given early in the development phase of a new system to:

1. The capability of the new system to be effectively operated by the planned available personnel;
2. The logistic support aspects associated with the system; and
3. The feasibility, suitability, and acceptability of the planned support program.

To achieve the purpose of this section, interfaces between the man and the machine (i.e., system hardware) must be considered. Two major areas are involved; Operability Assurance, which examines the "operator"/machine interfaces and Supportability Assurance which includes the "maintenance man"/machine interfaces.

Safety requirements must be consistent with operational requirements. The Operability and Supportability Plan shall examine the application of appropriate safety engineering principles.

11.1 Operability Assurance

11.1.1 Man-Machine Interface

The objective here is to set forth the manner in which the system configuration has been and will be analyzed from the standpoint of the interfaces between the operator and the system hardware. Include a brief description of the following (correlating with information which may be stated in the Personnel Recommendations section of the SOR document):

1. Personnel Interface Points and the Operational Sequence Flow Diagram;
2. Human Capability Considerations—Operator and maintenance skill levels and associated capabilities for each personnel interface point.

These preliminary man-machine interface determinations form the basis for planning the activities that will assure optimum operability and for assigning responsibilities of participating organizations during each phase of system development.

Plans for accomplishing the following objectives during the design stage of system development should be stated:

1. Continued refinement and updating of the human factors data essential to assure personnel feasibility and optimum utilization of personnel. To this end, RFP's should contain human factors specifications and other background information necessary to enable contractors to consider specific qualifications of Naval personnel with regard to the following:
   a) Physical interface between personnel and equipment;

b) Design of displays and controls;
c) Arrangement of working spaces;
d) Consideration of support and safety factors.

2. The Bureau of Naval Personnel should provide specific information about the quantity and capabilities of personnel and the training facilities available which affect the operability and supportability of the system.

Plans for accomplishing the following objectives during the prototype phase of system development should be stated:

1. Determination of the operability of system equipments;
2. Conduct of human factors evaluations of the prototype system;
3. Validation of quantitative and qualitative manning and training estimates.

Plans for final validation of systems operability during the test and evaluation phase of system development should be stated. Reference should be made herein to SECTION 12 of the TDP.

11.1.2 Operation Manuals

The manner in which the operation manuals will be developed should be stated. (The verification of these manuals may be covered in SECTION 12.)

11.1.3 Operator Training

The manner in which training courses will be developed should be stated. (The details of the personnel training program will be covered in SECTION 13.)

11.2 Supportability Assurance

11.2.1 General

This section of the plan sets forth the manner in which the system configuration has been and will be analyzed from the standpoint of the interfaces between the maintenance man and the system hardware. Also included should be the manner in which the required logistic support resources are to be determined and provided for the total integrated support of the system.

11.2.2 Initial Requirements

An initial requirement for implementing effective support planning is the establishment of an information generation, collection, processing and analysis system. It is assumed that the central control point for such a system will be provided by the PDA with certain information generation responsibilities delegated to other organizations. Two primary reasons for this assumption are:

1. Access to a computer program and computing equipment will be provided by the PDA.
2. The contractor must generate and document basic design information concurrently with design development. Since this information is already paid for in the purchase price of the equipment, the PDA would simply capitalize on the information availability.

11.2.3 Assignment of Responsibilities

There are numerous ways in which the supportability planning responsibilities may be shared between the Navy and Industry. Effective use should be made of in-service capabilities and duplication of efforts must be avoided. Final decisions will necessarily depend on the number of information requirements and time constraints. An important fact, however, lies in the recognition that considerable information does come into existence during the planning and development phases. It remains only to extend information requirements where necessary and provide a plan outlining time-phasing and documentation procedures.

11.2.4 Time-Phased Support Actions and Predictions

Since complete support planning is based on inherent equipment and support system characteristics, it is realized that, at the time of submission of the TDP, much of the information pertaining to operational support cannot be accurately stated. However, during each stage of system planning and development, certain additional information becomes available. As a result, at some time during each stage, decision capabilities develop which enable progressively greater definition of the support plan. This section of the TDP should contain a tabular display of logistics and maintenance information availability, and decision capabilities referenced to each stage of system development.

Because there are always elements of uncertainty in research and development programs, time commitments should always be referenced to the contractual time-phasing or proposed time goals established for the system under development. The standard Program Evaluation and Review Technique (PERT) offers an excellent starting point for time-phasing. With such a monitoring scheme provided by the PDA, logistics and maintenance planning information requirements can be incorporated into the system development program at contract award. This concept could be extended such that the proposer incorporates in his PERT program proposed information availability dates in accordance with dictated information requirements. The important aspect that must be maintained is that certain information must be available at a specified time prior to initiation of intended work effort in order that evaluations of decisions be made without delaying the work progress.

11.2.5 Information Flow

The basic functional activities involved in supportability planning along with information flow lines are shown in Figure 11-1. Detailed responsibilities should be developed for each activity along with techniques of prediction and/or measurement and documentation procedures. Typical roles played by each activity are briefly described below:

Logistic parameters as stated in the SOR document are provided to the hardware contractor who will establish:

1. Prediction and/or measurement of those elements of logistics that relate to the operational readiness of the total system.
2. Documentation of this information in a form compatible with project management requirements.

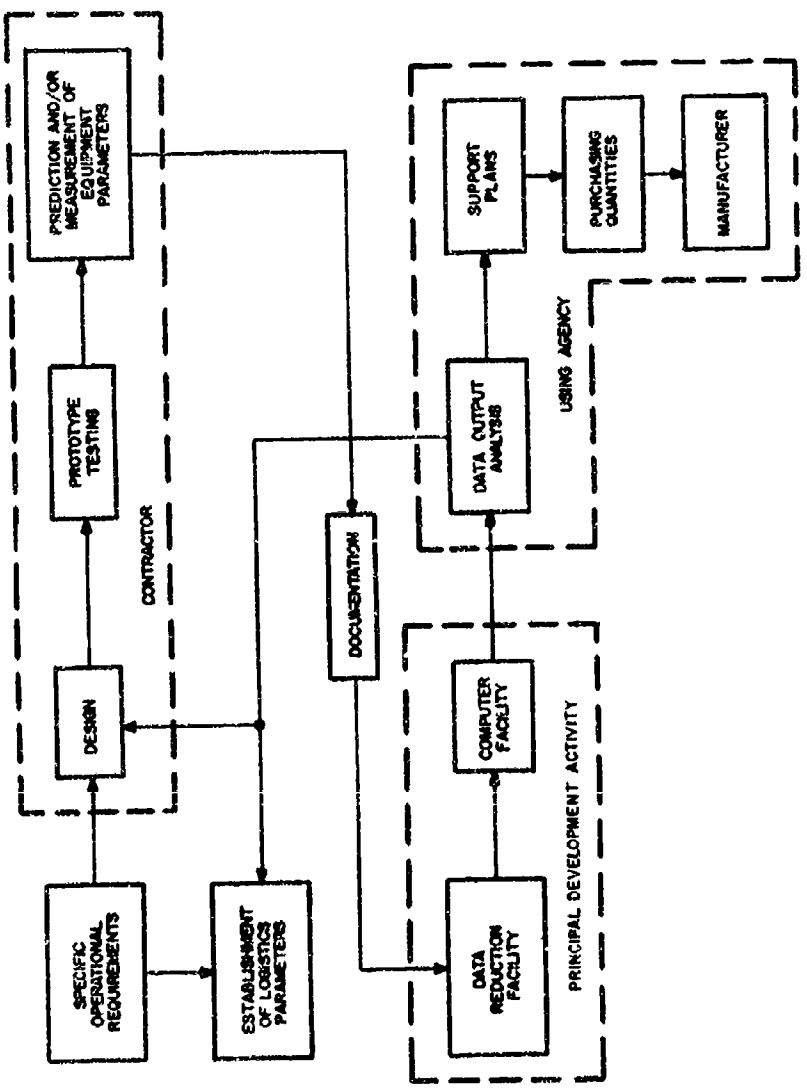


Figure 11-1. Supportability Plan Functional Activities and Information Flow Lines.

The PDA will be responsible for:

1. Reduction of the information to a form compatible with and expedient for the particular computing machinery.
2. Computer processing of the information.

The Using Agency will be responsible for:

1. Analysis of the printout of the information.
2. Derivation of a support plan.
3. Establishment of purchase quantities and time-phasing for purchasing of required commodities.
4. Providing a feedback loop to the contractor for go-ahead decision on superior design where alternate design configurations are being evaluated.

11.2.6 Facility Requirements

Identify all new and modifications to existing facilities required to support the system. Facility requirements for all phases should be included; i.e.:

Development
Evaluation and Test
Assembly, Installation and Checkout
Repair and Maintenance
Distribution and Storage

If facility requirements are given elsewhere in the TDP, make appropriate reference as to section and paragraph.

11.2.7 Spares and Repair Parts

State the plan for the determination and depth and scope of repair parts, the method of acquisition, and the distribution according to the maintenance echelons involved. Include specific mention of the plan for augmented support when applicable.

11.2.8 Packaging and Handling Equipment

Determine and state the packaging and handling equipment requirements essential for the preservation, facility of transportation and storage, etc., for the various elements of the system.

11.2.9 Support Equipment

The plan for determining the requirements for test equipment, special tools, and calibration equipment must be stated, and definitive plans for the development, test, acquisition, and distribution of support equipment must be formulated.

11.2.10 Operational Logistic Factors

Indicate any known or anticipated factors that will or could affect underway, in port, or advanced base replenishment processes related to the system, and provide alternative means of accomplishment whenever possible.

11.2.11 Contractor Technical Services (CTS)

Indicate the requirements for CTS during the life cycle of the system.

11.2.12 Maintenance Personnel and Training

State the relationship of personnel and training requirements to the Supportability Plan and make reference to the personnel and training plans contained in SECTION 13.

11.2.13 Integrated Logistic Support

Describe the overall integrated logistic support management approach and the manner in which logistic information will be generated and will flow between the contractor, the PDA, and the supply activity.

11.2.14 TDP Sectional Interface

The Supportability Plan is directly related to the Maintainability Plan (SECTION 10) and the Test and Evaluation Plan (SECTION 12). The specific nature of these relationships should be described.

11.2.15 Relationship to Procurement Documents

Since the planning information contained in this section of the TDP describes how the operability and supportability of the system will be assured, the substance of the plan must be communicated to the contractors participating in the definition and development of the system. This responsibility should be specifically assigned.

TDP Check List

SECTION 11

Operability and Supportability Plan

1. Does the Operability Assurance Plan include the following?
   a) Identification of the expected or foreseeable man-machine interface problems and a discussion of the possible approaches to the solution of these problems.
   b) Establishment of features of human engineering design to assure optimum operability.
   c) Relationship of quantities, capabilities and training of available personnel to the operability of the system.
   d) Indicate consistency of safety requirements with operational requirements.
2. Does the Supportability Assurance Plan include the following?
   a) A statement concerning the feasibility and the extent of support required during all phases of the system life cycle, including human resource feasibility.
   b) Schedules, quantitative figures, estimates, objectives and responsibilities related to the following support actions:
      (1) Facility requirements
      (2) Repair parts acquisition and distribution
      (3) Test equipment, special tools, etc.
      (4) Packaging and handling
      (5) Technical information
      (6) Operational logistic factors
      (7) Contractor technical services
      (8) Safety requirements
      (9) Integrated logistic support

SECTION 12

Test and Evaluation Plan

12.0 General

The purpose of this section of the Technical Development Plan is to present plans for major tests, including experimental trials, investigations, working environment appraisals, and formal evaluations wherein the objectives may encompass one or more of the following:

(1) to supply knowledge and experience for the determination of feasibility for continued development or for design checking;
(2) to establish assessments of the status of development of the system or one of its critical components;
(3) to determine the suitability of and to provide the basis for certification that the developed system is suitable for formal operational evaluation (OPEVAL) as conducted by the Operational Test and Evaluation Force (OPTEVFOR); and
(4) to provide logistic, technical, and planning support and services as may be required during the OPEVAL.

The presentation of plans for test and evaluation should cover: funds; schedules; assignment or indication of proposed responsibilities; provision of facilities, equipment and personnel; training and indoctrination of civilian and/or military personnel; geographical test site requirements; requirements for Fleet services, including aircraft, ships, shore facilities, and personnel; description of the test and evaluation rationale whereby system performance, reliability, maintenance, operationability, and supportability will be established in the operational environment; and liaison between the PDA and Fleet activities.

Tests and evaluations involving Fleet services are the subject of OPNAV Instruction 3960.1 series which is a comprehensive guide recommended for the use of PDA's in preparing plans for SECTION 12.

It is important that standards for judging acceptability of the finally developed system be established early in the project development to ensure the concentration of those standards. Once established, these standards should only be changed by formal action in writing which has been concurred in by both the user and the producer organization after the consequences of such changes in terms of operational capabilities or resources are fully considered. The test and evaluation program should therefore be oriented towards measuring these parameters in an environment as close to final as is possible. The TDP should set levels of acceptance or rejection of the system so that the plans may be oriented towards determining these system characteristics. Definitive quantitative levels of target and minimum acceptable performance should be stated.

Since the number of equipments to be evaluated is generally small in comparison to the ultimate production, care must be taken in interpreting the results of the tests. The sample size should be chosen with an eye towards measuring

performance with a specified confidence level. In this section, the PDA should specify the number of equipments to be tested, the time to be allotted for testing and the expected confidence level in the test results. An evaluation of one equipment, for example, a radar system, may not quantitatively establish a meaningful confidence level since the operating period may be too short.

In numerous developments final test and evaluation is found to consist of two phases: the technical evaluation (TECHEVAL) and the OPEVAL. The TECHEVAL is the primary responsibility of the PDA with assistance in conducting the operational planning from COMOPTEVFOR. The OPEVAL is the primary responsibility of COMOPTEVFOR. The PDA, however, must plan to assist COMOPTEVFOR and provide contractor assistance as requested. Since the results of the OPEVAL are generally of decisive importance, COMOPTEVFOR will formally report tests results as and when directed by the CNO.

Figure 12–1 illustrates a typical relationship between the participants in the test and evaluation program and indicates their contributions and responsibilities. It is possible to delegate these responsibilities to other agencies, both governmental and industrial. The PDA should define the actual participants and their responsibilities in this section. Not only should the scope of each participant's contribution be defined, but a schedule should be established defining when the output from each participant is required.

The PDA should include in the TDP a plan covering the general areas of what must be done, when it will be done and who will do it. The plan should be concurred in by the Fleet operational activities involved.

12.1 Detailed Plan Outline

The degree of detail provided in this section in regard to the Test and Evaluation Plan is necessarily a function of the status of the project at the time the TDP is written. If the project is in the early stages of development, this section should describe a general program for test and evaluation. If the developments are almost completed then the emphasis of the entire project will be on test and evaluation and SECTION 12 of the TDP should reflect this emphasis.

The Brief Development Plan described in SECTION 4 should detail the project events leading up to final test and evaluation phases. This section (SECTION 12) should describe plans for the detailed test and evaluation events.

An illustrative outline for a test and evaluation plan is described in the following paragraphs. Although the actual plan will vary among projects, the outline should be considered as a guide in generating the detailed plan.

TEST AND EVALUATION PLAN OUTLINE

Part 1.0 Objective of Test

This section should briefly describe the objective(s) of the test and its relationship to the overall project development. It should state who has responsibility for what and when.

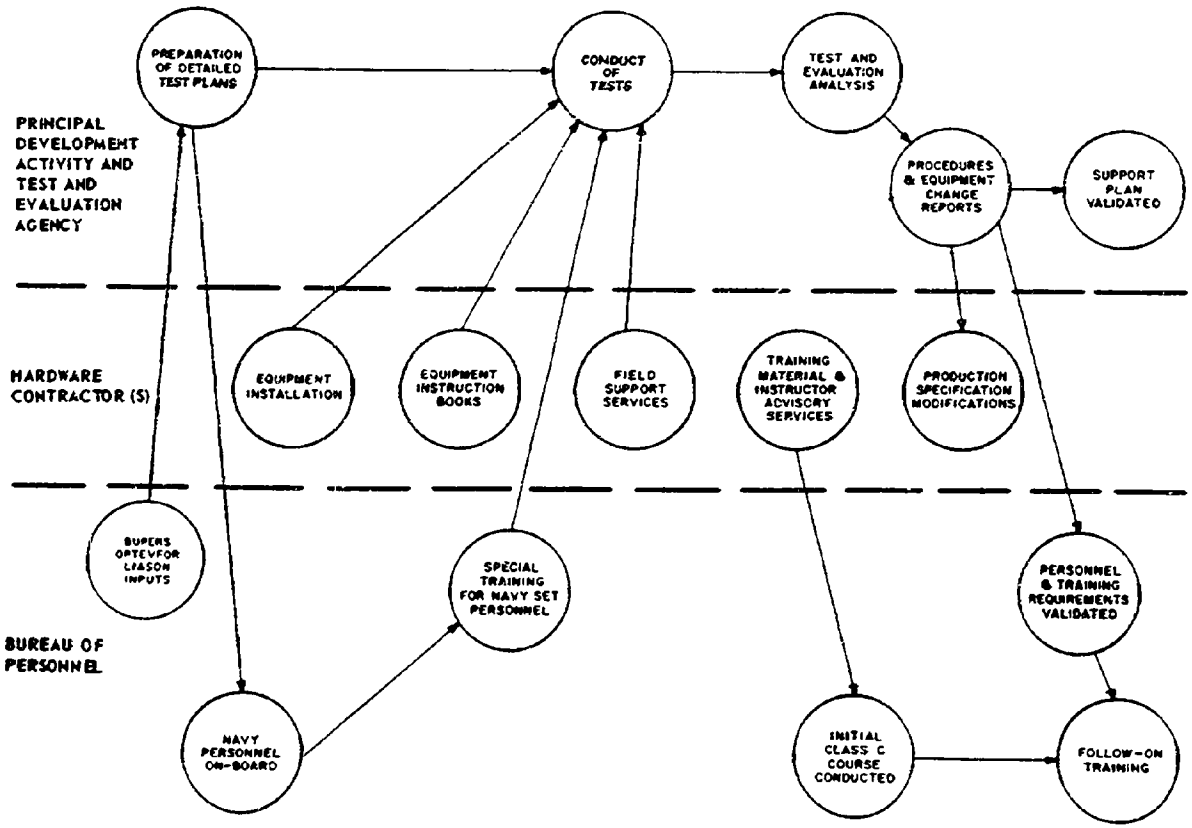


Figure 12-1. Test and Evaluation Participants and Responsibilities.

Part 2.0 Scope and Limitations

In this part, the PDA should indicate the extent to which the planned tests will provide reliable results, including confidence levels where applicable. For example, the TECHEVAL may not be totally conclusive due to a lack of one or more of the associated systems as described in SECTION 9. It will be necessary to simulate the interfaces with these systems and as a result of this simulation, however accurate it is, an uncertainty as to final interface compatibility will exist which should be discussed and estimated as to its importance.

The plan should describe the characteristics and operational features of the system which can be evaluated with a high degree of confidence while pointing out those aspects of system performance and operation which can only be evaluated on a simulated basis.

Part 3.0 Equipment to be Evaluated

This section should include a tabulation of all equipment to be evaluated. As a subsection of this section, the plan should identify other factors such as operational procedures, maintenance procedures, adequacy of training courses, safety considerations, and human factors compatibility which will be evaluated with the equipment. Special emphasis shoud be placed upon creating an artificial operating environment closely approximating the final environment where new operating procedures and new operating and maintenance skills required for satisfactory final system operation can be evaluated with the equipment. Requirements to be included will often be generated by other sections of the TDP such as SECTIONS 8, 10 and 13.

Part 4.0 Test Locations and Special Facilities

This section should identify the geographic location(s) which will be considered test sites. Any special facilities required for the successful conduct and completion of the program should be enumerated.

Included in this section should be an estimate of the number of personnel associated with the test who will require living quarters on site. Any special transportation needs, military vehicles, airplanes, or site maintenance personnel required should be indicated.

The PDA should specify all facilities and services which it is proposed that local commanders will supply.

Part 5.0 Description of Test Phases

In general the test and evaluation program will have a number of phases such as equipment installation, unit checkout, sub-system interface test, subsystem operational test, overall system test, and, importantly, final reporting.

The scope of each of these test phases should be defined and their interdependence clearly established. Where applicable it should be pointed out that unforeseen problems arising in, for example, a sub-system interface test may require equipment redesign or field modification and could result in a change of scope and schedule in later test phases.

This section should tie in closely with Part 6.0 below.

Part 6.0 Test Schedule

A chart illustrating the overall test schedule and its various phases should be prepared. The schedule should include at least the following critical events and periods:

a) Arrival on site of each equipment
b) Expected installation period for each equipment
c) Estimated checkout times
d) Milestone indicating "equipment ready for test and evaluation"
e) Arrival on site of test equipment and simulators
f) Estimated period for interface tests
g) Sub-system TECHEVAL
h) Reporting of results
i) Start of sub-system operational tests
j) Start of overall system operational test

In SECTION 14 of the TDP, Production Delivery and Installation Plan, provision should be scheduled to allow adequate time for specification rewrite and review based on OPEVAL findings.

Part 7.0 Test Organization and General Manpower Requirements

This section should describe the entire organization and personnel responsibilities for the test and evaluation program. This is especially important since the plan may bring together many different contractors and governmental agencies, many with overlapping interests, hence, there is a need for definitive planning. The PDA responsible for the test program should designate one of its project engineers as the test and evaluation director.

When the tests will be conducted in an area under the cognizance of a local military commander, the plan usually should indicate a need for a liaison officer from the local activity who will be responsible for arranging for local services, personnel, and facilities as required in the test plan.

If the PDA plans to employ contractor technical services to assist in the test, the organization chart should show the relationship of the contractor to other contractors or agencies involved. A single contractor representative should be designated for each contractor for the purpose of providing a single contact point for technical and administrative problems associated with the test and evaluation program.

An organization description should complement the organization chart. This description should clearly delineate the lines of authority and responsibility. Of particular importance is the need to establish the procedures for contractor/government liaison especially in regard to contractor/military working relationships.

Part 8.0 General Data Logging Requirements

This section should describe the general logs which will be kept during the tests. Examples of such logs presented here for consideration are the following:

Operating Log—This log would note the date of operation, the personnel and the period of their participation and the nature of the work performed, i.e.,

operation, maintenance, training, debugging, etc., and any remarks pertinent to the particular item or time period.

Change Log—This log would record any changes, classified as temporary or permanent, made to any equipment, module, display or cable, procedure or personnel requirement, the reason therefor, and the results of the change. The date of the change would be noted and in the case of temporary changes, the time the change was installed and the time it was removed.

Recommended Change Log—This log would contain a list of changes recommended for future application or review and which would require modification(s) to equipment or system specifications or personnel and training requirements. The record shall contain sufficient descriptive detail and any necessary diagrams and sketches so that subsequent review need not depend upon the memory of participating personnel.

Such logs, together with the test data, would record the output of these portions of the test and evaluation plan which are under the cognizance of the PDA and could be used for reference when production specifications are being modified.

Part 9.0 Detailed Test Procedure Requirements

This section should not contain the detailed test procedures. However, it should establish basic requirements as to the scope of each test phase.

Part 10.0 Reporting Requirements

In order to provide the operational users, the PDA, and other groups with the data from which a technical and operational evaluation of the system concept and hardware can be formulated, the following reports or their equivalent should be considered for preparation at the conclusion of any major portion of the test and evaluation program:

a) Sub-system Test Reports—to be issued at the conclusion of sub-system test phases. These reports will be of an interim nature and will include the following:
   (1) A decription of any deviation required from the detailed test plan, equipment configuration or test procedures
   (2) All equipment logs, test results, equipment modifications, maintenance reports, etc.
   (3) Recommendations for equipment or system changes.

b) Sub-system Summary Report—to be issued at the conclusion of all sub-system tests. This report should present a distillation of all equipment and sub-system test results and preliminary recommendations.

c) Interim System Operational Report (OPTEVFOR cognizance)—to be issued at a point in the OPEVAL where a valid evaluation of proposed operational, maintenance and training procedures can be made.

d) Final Report—to be issued at the completion of the program. This report will summarize all the test results and operational evaluations and should present recommendations for incorporation into production specifications, personnel and training plans, reliability and maintainability plans, operability and supportability plans and, if applicable, into the production and installation plan. The impact of the test

results on final operational dates should be evaluated if the conclusions of the test indicate a need for major redesign or modification.

Part 11.0 Test Equipment Requirements

A tabulated summary of all standard and special test equipments required for system operation, calibration and maintenance should be included in this section. Plans should be described indicating the method by which each item will be made available, e.g., off-the-shelf purchase, special construction or standard equipment to be supplied by local authorities.

The table should be cross referenced to the Test Schedule, Part 6.0, indicating the required availability dates for each test equipment and the test in which it will be employed.

Part 12.0 Glossary and Abbreviations

All special terms and/or abbreviations used in the text of the Test and Evaluation Plan should be defined in this section.

TDP Check List

SECTION 12

Test and Evaluation Plan

1. Have overall levels of acceptable performance been included?
2. Have test and evaluation criteria (target and minimum acceptable) been cited?
3. Has an estimate of confidence level in test results based upon the number and duration of trials and the number of equipments evaluated been made?
4. Does the plan clearly delineate the responsibilities and relationships of all agencies, contractor and government, in preparing for the test and evaluation phase?
5. Does the plan agree with the development schedule in regard to the test and evaluation detail provided?
6. Have training programs been planned and scheduled for test, evaluation, installation, and maintenance personnel?
7. Has early liaison with test activities been planned?
8. Have provisions been made for analysis of test results, the publication of results, and the drafting and reporting of recommendations based on the tests?

SECTION 13

Personnel and Training Plan

13.0 General

The personnel and training section provides planning estimates of the military and civilian personnel and training requirements necessary to the successful development of fleet introduction of a given equipment system. This section is not normally required of TDP's responding to an ADO.

13.1 Responsibilities

The Chief of Naval Personnel (CNP) determines the feasibility of supporting equipment and system developments within the scope of the Navy's current and future personnel potential, provides the personnel to man and maintain all systems developed and (for training other than Aviation, Medical, and Reserve) acts as overall manager for the details of implementation and execution of the training plan. Since the CNP is solely responsible for providing personnel to man systems approved by CNO and is the training authority to the extent indicated above, it is obvious that SECTION 13 of a TDP must have the concurrence of the CNP to be valid and effective. If it does not contain the plan which the CNP is following, the TDP is misleading with regard to this critical element.

The preparation and development of SECTION 13 of the TDP requires close coordination between personnel of the NMSE and Bureau of Naval Personnel (BuPers). To insure that training and personnel requirements are determined prior to the introduction and operational use of new development systems, timely and close liaison is required.

The PDA having responsibility for the design, development or modernization of technical equipment for service use has the following specific responsibilities in the personnel and training areas:

1. Insure that technical documentation is provided to support initial training.
2. Provide estimates for personnel of industrial organizations to insure efficient installation and checkout.
3. Provide and budget for training equipment and related material and aids for purposes of training or instruction in operation and maintenance of such equipment.
4. Coordinate, clear and obtain internal technical bureau approval of personnel and training aspects of new developments under its cognizance.
5. Provide and coordinate with the CNP continued opportunity to develop and refine personnel and training estimates, and supporting data until Fleet introduction is completed.

To assure close coordination of personnel requirements and the training program with material developments, the CNP has, with the support of the host

bureaus, situated personnel research groups in BuShips (Code 742C) and BuWeps (Code PRG) and the Special Projects Office (Code SPPE). These offices are available to assist in the preparation of all sections of the TDP in which personnel and training requirements or information are necessary, and specifically to clear SECTION 13 with the Assistant CNP for Plans (Pers A) and the Director, Personnel Program Management Division (Pers A4).

Figure 13-1, adapted from "The Bureau of Naval Personnel New Developments Human Factors Program," Personnel Research Report Number 64-51 of February 1964, shows the interface points between the PDA and BuPers. The functions of various codes within BuPers in the preparation of SECTION 13 are also shown. It must be emphasized that determination of personnel support cannot be finally accomplished without prior determination of the maintenance requirements, which affects the skills and knowledge unique to the system at each maintenance level.

13.2 Procedure

The forms for SECTION 13 are to be completed with the best information available at the time of initial submission of the TDP and estimates included are to be refined on each subsequent review and resubmission. Guidelines for developing a training plan and the follow-on training plan work sheets are contained in OPNAVINST 1500.8 series. Information being developed concurrently for the TDP sections concerning sub-system characteristics, associated system characteristics, and, particularly, the dependability, operability and supportability plans should be referred to during the preparation of both the initial and succeeding submissions. Relatedly, information developed for SECTION 13 will usually be directly applicable to information required for SECTIONS 2, 4, 5, 6, 8, 10, 11, 12, and 14.

The key to all information contained in this section is the estimated manning for the equipment or system. In establishing the number of each level of personnel who will operate and maintain the system, several sources may be employed. The SOR will provide an indication of the proposed mission.

From the mission, operational requirements are defined, organized and analyzed in order to identify system functions and implied equipment subsystems. Knowing system functions, the next step is to relate these functions to the man-machine interfaces which they comprise and to describe those functions to be performed by man. External workload must be analyzed in order to determine the peak simultaneous load that the system will be required to handle. Task requirements are then determined in terms of the specific interactions of men with machines and the system environment as they relate to the accomplishment of the system mission. The time required to perform each task and the frequency thereof are estimated. Estimates for maintenance positions will be more difficult to obtain than those for operator positions, in that time is a function not only of the time required for a given maintenance task area, but also of the frequency with which the task must be done and the skill of the individual maintenance technician.

Total workload imposed on operator and maintenance personnel by the combination of external load and task requirements can then be established. Tasks and associated equipment components are examined to establish the logi-

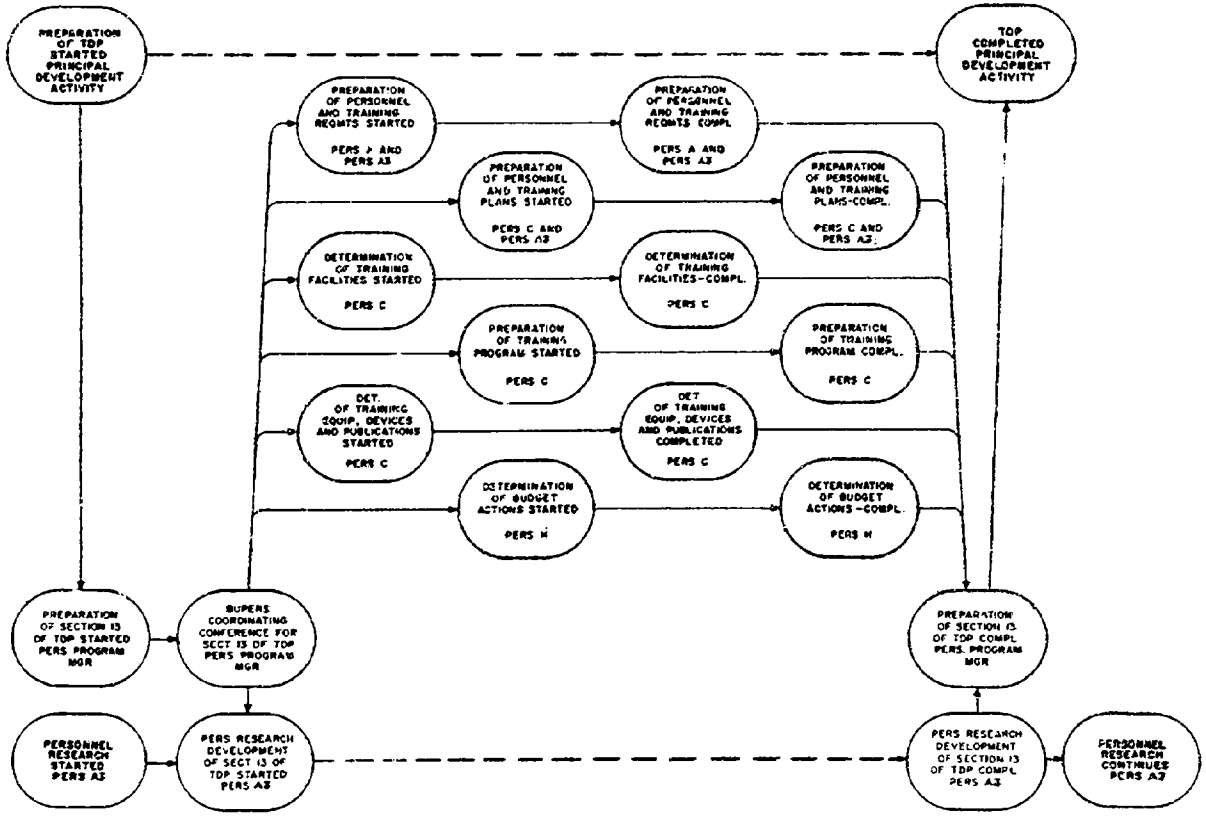


Figure 13–1. Milestones in the Preparation of Section 13 of a Technical Development Plan.

cal tasks groupings that can be accomplished by a single position, and thereby the position hierarchy and structure are developed.

Knowledge and skill requirements are then related to the tasks that must be performed at any given position. Based on the operating and maintenance concepts and the results of the aforementioned previous analyses, the number of operator and maintenance personnel required to man the system is determined. Since these estimates are difficult to derive, and detailed system information is not yet available at initial TDP stages, the best source of data is from existing comparable systems and common or comparable units or subunits.

The current BuPers training program is reviewed in order to determine the extent and coverage of existing pertinent training programs, and new training requirements are identified for Factory, BuPers, and Fleet Schools.

The process of estimating required personnel should be accomplished within the following guidelines:

1. Manning must provide for performance of all day-to-night activities required of the personnel in the system.
2. Organization and manning must comply with stipulations in such directives as U.S. Navy Regulations, NWP50A and NWIP50–1.
3. Manning must provide for scheduling of normal work periods and off-time, with sufficient personnel to keep the system in operation for long periods of time.
4. Manning must provide for performance of all emergency actions that can feasibly be anticipated.
5. Manning should incorporate as few different jobs as possible.
6. Manning should require a minimum of training time in order to fulfill and maintain the fully manned strength of the unit.

Examples of detailed procedures developed by BuPers for determining personnel and training requirements can be found in the "Bureau of Naval Personnel New Developments Human Factors Program" Personnel Research Report ND 64–51, February 1964, "Bureau of Naval Personnel New Developments Personnel Planning Information Documentation Procedures and Formats," Personnel Research Report ND 65–10, November 1964.

13.3 Contents

The following specific items should be included in the Personnel and Training Plan:

1. A summary of personnel requirements.
2. A list of planned equipment installations.
3. Indications of new skill and knowledge requirements.
4. Required training facilities.
5. Operation and maintenance billet requirements per equipment/system and Navy unit.
6. Information on necessary training at factories and service schools.
7. Staff requirements at service schools including contract instructor services.
8. Equipment and test equipment needs for service schools.
9. Training device and training aid requirements.
10. Projected contract engineering service requirements.

11. The necessary curricula, training material and technical publications.
12. Required training and personnel studies.
13. Budgetary actions essential to the timely implementation of Personnel and Training Plans. (All funding information necessary to support the personnel and training requirements shown in this section must also be included in SECTION 6, Financial Plan, in sufficient detail to permit correlation.)

TDP's frequently state that a new Navy Officers Billet Code (NOBC) and/or a new Navy Enlisted Classification (NEC) will be required. It is essential that this need be established and listed in the TDP. This is particularly true of NEC's which can be established for requirements and training planning only and placed in Part II of the NEC manual.

The TDP must define, within the training requirements, the proposed allowances for new equipment or systems. These should, as accurately as possible, list the minimum manpower requirements of the system or equipment and must reflect approved staffing criteria. Review of proposed allowances through CNO (OP 10) prior to publication in the TDP will greatly assist in meeting these objectives.

This section should contain a list of installation dates of new equipments or systems. For effective manpower requirements planning, the installation of each unit of equipment must be specified by activity and fiscal year and the month within the fiscal year if possible.

13.4 Summary of Input Requirements

TDP development is an iterative process which overlaps both the planning and design phase of a system. The personnel and training analysis which forms the basis of SECTION 13 is a developing process which provides successively more accurate and comprehensive data. Certain inputs are necessary to such an analysis. These inputs include the following:

1. Detailed system and mission description.
2. Specific sub-system descriptions and specifications.
3. Operational readiness requirements (including MTBF, MTTR, manpower and load).
4. The operating and maintenance concept (e.g., level of shipboard repair).
5. The echelons of maintenance and support.
6. The sub-system functions allocated to man.
7. The similarity of human functions to those in existing systems.
8. A description of the existing Navy classification structure as relevant to the planned system.

If all TDP's are properly prepared and kept current, as directed by OPNAVINST 3910.4 series, constructive long range plans for BuPers managed schools should be effective in providing adequate personnel to meet the future Navy needs.

13.5 References

Many guides exist for accomplishing personnel and training requirements determination. An extensive bibliography is found in "The Bureau of Naval Personnel New Developments Human Factors Program," Report Number 64-51 of

February 1964. Current editions of the following reference and instruction documents are among those that are helpful and/or necessary to complete SECTION 13 properly:

(a) Manual of Qualifications for Advancement in Rating—NAVPERS 18068 series.
(b) Manual of Navy Officers Classifications—NAVPERS 15839 series.
(c) Manual of Navy Enlisted Classifications—NAVPERS 15105 series.
(d) Manual of U.S. Naval Training Activities and Courses—NAVPERS 91769.
(e) Organizational Planning for Navy Units—NAVPERS 18371.
(f) Financial Responsibility for the Training and Instruction of Military Personnel—NAVCOMINST 7110.8 series.
(g) Staffing Criteria Manual for Activities Afloat—OPNAVINST P5310.6.
(h) Staffing Criteria Manual for Activities Ashore—OPNAVINST P5310.5.

TDP Check List

SECTION 13

Personnel and Training Plan

1. In determining the personnel and training requirements, have the following items been considered?
   (a) the number and type of operator stations
   (b) the anticipated operating and maintenance tasks and loads
   (c) the critical and/or unique tasks and the skills and proficiency involved in each
   (d) the environmental conditions and their possible effects upon performance
   (e) the possible trade-offs which may exist among the personnel and training variables
2. In preparing the TDP, has adequate information concerning those items listed in Section 13.3 been provided?
3. In the preparation of SECTION 13, has provision for all standard and special test equipment required for the system been made?
4. If the TDP requires new billets, has this fact been included in a PCP action for approval?
5. Are the schedules for personnel training consistent with development, production and installation schedules delineated in SECTIONS 4 and 14?

SECTION 14

Production, Delivery and Installation Plan

14.0 General

The purpose of this section is to establish a method of providing the information required by operational and logistics planners responsible for fleet introduction and operational use of the system. The SOR will generally indicate the number of systems required to support the mission requirements analyzed and described in SECTION 4. Every effort should be made to include in this section the estimated lead time, planned actual production, classes of ships or units to receive the equipment, shipyards and facilities involved, and when determined, the estimated dates for installation in specific ships or units. Estimated unit costs, unit installation costs, and annual unit maintenance cost, and recommended economical buy should be included, particularly if production quantity estimates are not given in this SOR. This section is not normally required in TDP's responding to an ADO.

NOTE: WHEN SECTION 9 OF THE PMP HAS BEEN DEVELOPED AND APPROVED, IT MAY BE INSERTED AS SECTION 14 OF THE TDP. IT IS INTENDED THAT SECTION 14, AS DESCRIBED HEREIN, WILL SERVE AS THE SKELETON WHICH WILL BE FLESHED OUT IN THE PMP. SUFFICIENT INFORMATION MUST BE INCLUDED IN THE TDP TO PERMIT MANAGEMENT DECISIONS TAKING ACCOUNT OF THE PRODUCTION, DELIVERY AND INSTALLATION IMPLICATIONS OF THE PROJECT DEVELOPMENT EFFORT.

14.1 Procurement and Production Planning

The procurement and production planning associated with a particular SOR will vary from the simple to the complex depending upon the degree of accuracy that can be projected in the areas of:

a) Estimating number of systems to be procured.
b) Estimating annual production rate.
c) Determining inventories at the end of each year.
d) Determining development and cost adjustments necessary to accelerate basic schedule.
e) Estimating earliest operational capability date.
f) Determination of time phasing and plan for transition from development to production.

14.2 Administrative and Development Lead Time

The principal development activity should indicate the lead times associated with the proposed development. There are two lead times that require definition to provide an overall picture of the time frame in which the program will be funded.

a) Administrative Lead Time—The period of time elapsing from the date the initial operational requirement document (SOR/ADO) is issued until the contract for RDT&E effort awarded.

b) Development Lead Time—The period of time elapsing from the date the RDT&E contract is awarded until the production contract for service use items is awarded.

14.3 Planned Production

A variety of charts can be developed depending upon the need for establishing the required data for the user. Figure 14–1 illustrates the simplest form that such scheduling can be accomplished. More detail scheduling of proposed production would include:

a) Delivery schedule by month/year
b) Proposed installation schedule
c) Inventory accumulation

	DELIVERY FY						
FUNDING FY	65	66	67	68	69		TOTAL
65							
66							
67							
68							
69							

Figure 14–1. Production Schedule Plan.

Figure 14–2 illustrates a recommended format for preparing data for production planning which includes the above.

14.4 Transition From Development to Production

A brief plan describing the transitioning from development to production should be prepared. A breakdown of key milestones to be attained during this period and the time phasing for their accomplishment should be developed To this end an Advanced Procurement Plan (APP) should be included as an appendix to the TDP.

14.5 Program Acceleration

In the event of an emergency, which would justify acceleration of the introduction of this system, indicate what action and estimated costs would be required to effect an early operational availability. What would be the earliest estimated operational availability date? What would be the special operator and maintenance personnel and training implications of such an accelerated introduction into service?

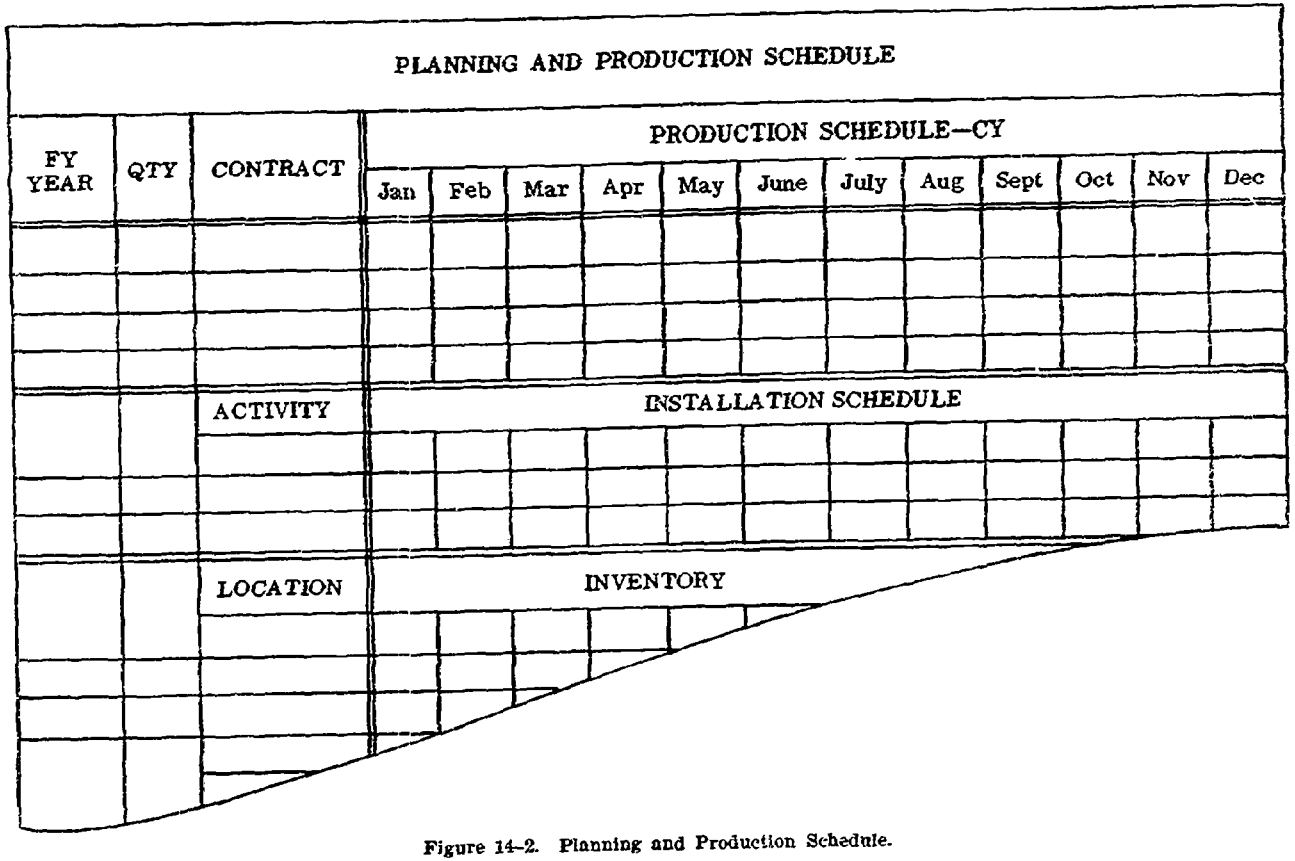


Figure 14–2. Planning and Production Schedule.

TDP Check List

SECTION 14

Production, Delivery and Installation Plan

1. Is estimated development lead time indicated?
2. Has the planned actual production schedule been prepared?
3. Does the SOR estimate of the number of systems required agree with the planned production?
4. Have inventory levels been determined?
5. Has an installation plan been developed?
6. Have estimated unit costs been prepared?
7. Check to be sure that estimated unit cost mulitiplied by the number of systems or units agree with the projected cost figure prepared for SECTION 6.
8. Has an APP been included?

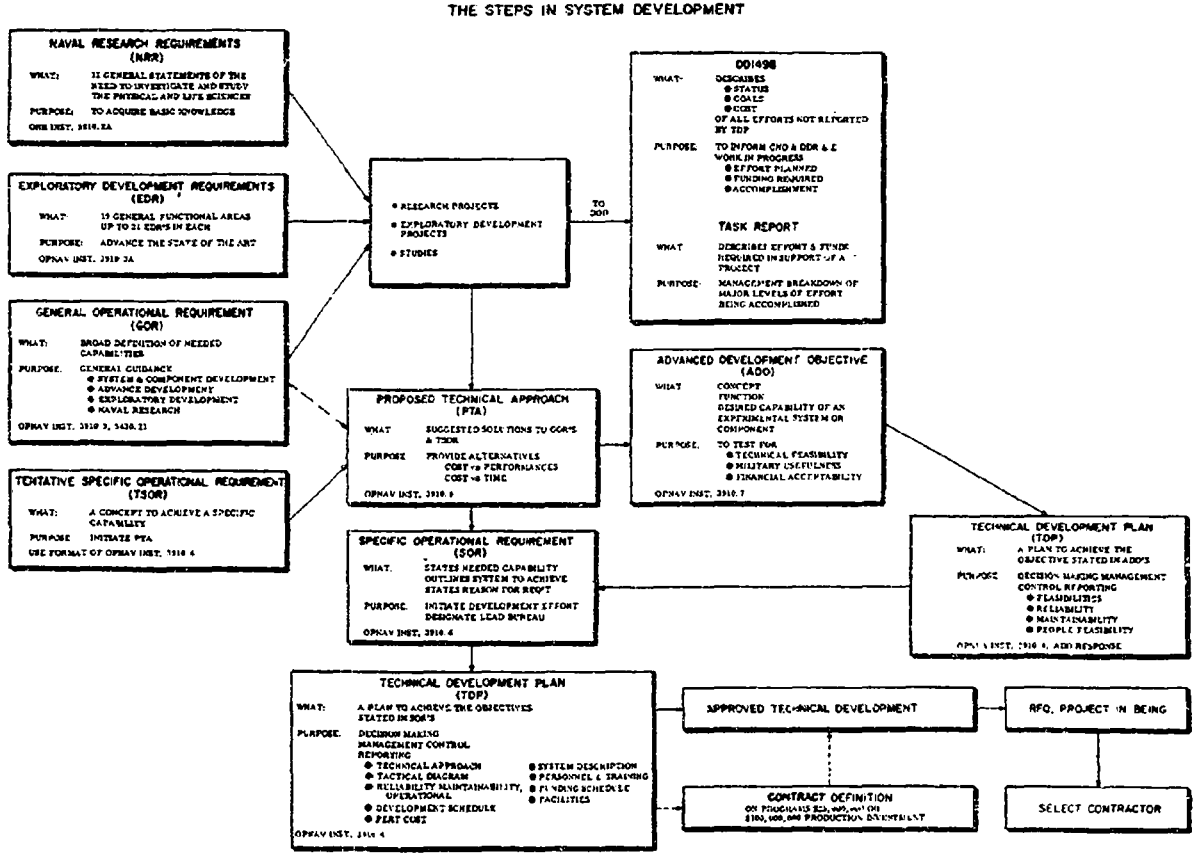
APPENDIX A

OPNAVINST 3910.4 Series

[PDA is to insert copy of the current edition of OPNAVINST 3910.4 Series here as a part of this guide. It is not to be included as Appendix A of the TDP.]

APPENDIX B

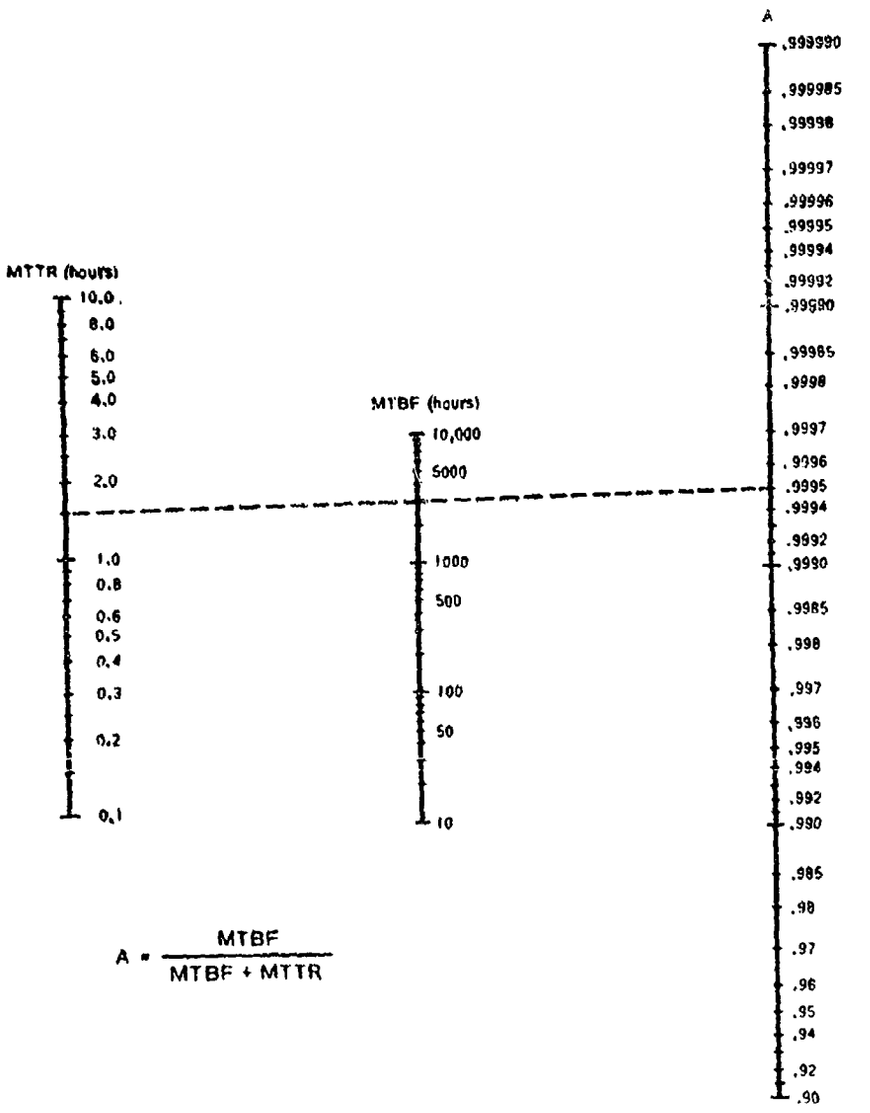
The Steps in System Development



B-1

APPENDIX C

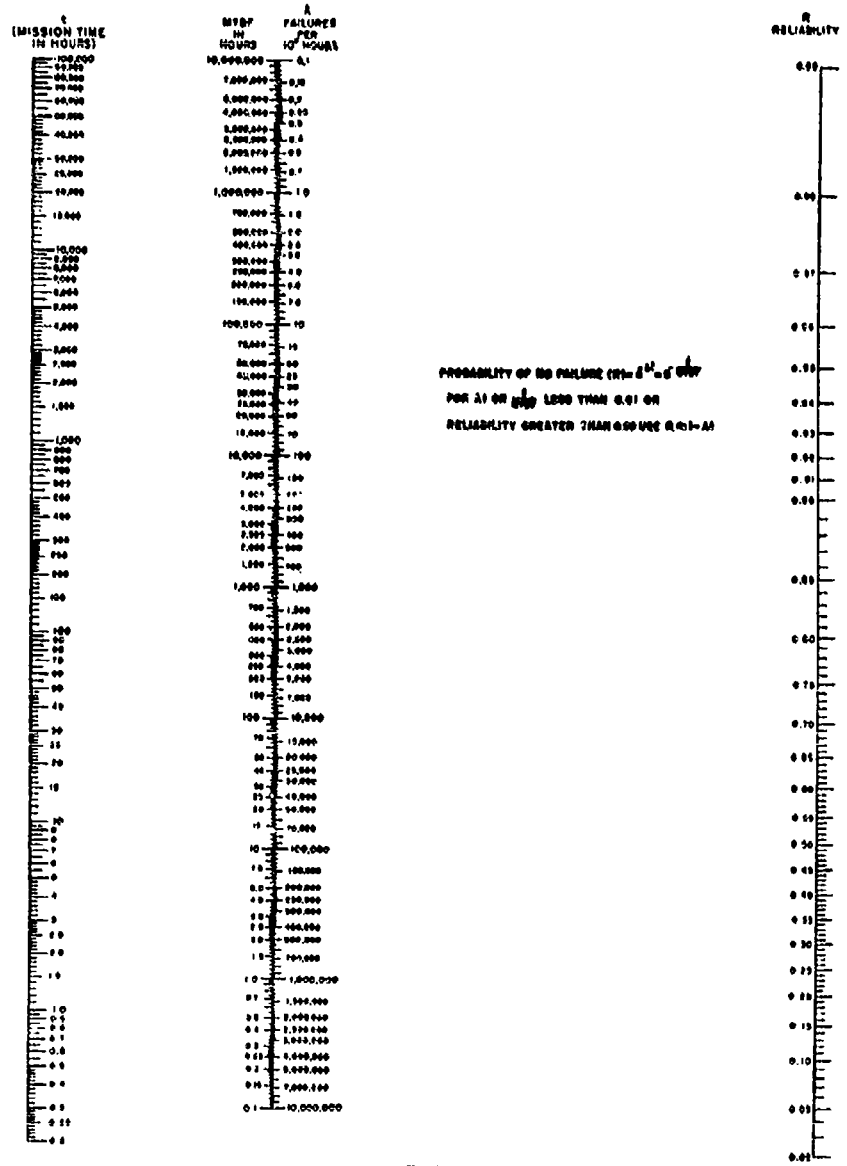
Availability Nomograph



$$A = \frac{MTBF}{MTBF + MTTR}$$

APPENDIX D

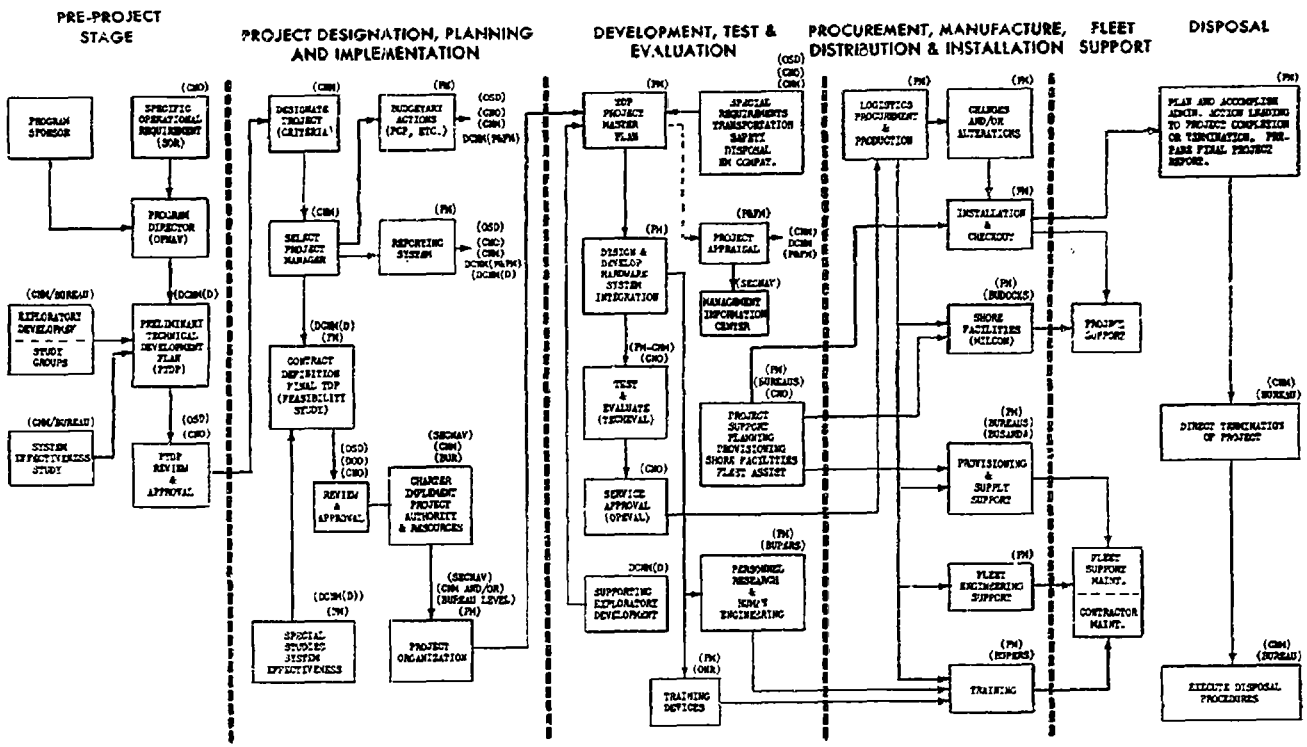
Reliability Nomograph



D-1

APPENDIX E

FLOW CHART FOR PROJECT MANAGEMENT



APPENDIX F

Sample Format—Design Interface Specification

SAMPLE FORMAT

DESIGN INTERFACE SPECIFICATION		
AGENCY_____ PROJECT NO. _____ SUBSYSTEM_____	INTERFACE BETWEEN _____ AND_____	DATE _____ REFERENCES:
ELECTRICAL SIGNAL TYPE:		PROJECT STATUS:
ACCURACY:		DATE REQUIRED -R & D:
TOLERANCE:		DATE REQUIRED - PRODUCTION:
ENVIRONMENT:		FUNDING SUPPORT:
PHYSICAL INTERFACE:		OTHER:

281-122 O-67—8

F-1

APPENDIX G

Supplementary Guidelines for the Preparation of TDPs

The list of supplementary guidelines presented below are not specifically included elsewhere in this Guide but are considered of value to those personnel involved in preparing TDPs. The listed guidelines stem principally from numerous reviews of TDPs conducted within NAVMAT, however, items are also included which were suggested by various activities of the NMSE, OPNAV, SECNAV and OSD.

The user of these guidelines should bear in mind that all of the guidelines presented may not pertain to a given TDP and are not offered as a substitute for sound judgment which must be exercised to insure a well prepared TDP. Within this context, the use of these guidelines is recommended. While there is no assurance that adherence to these guidelines will produce fully adequate TDPs, past evidence strongly indicates that those TDPs which do adhere to the listed guidelines, where applicable, are generally reviewed and processed more quickly than those which do not, eliciting fewer delaying questions or criticisms.

1. Write for the technically competent, but non-specialist, reader. Be concise.

2. Avoid the use of jargon. Where the "technical terminology or characteristic idiom of a special activity or group," i.e., jargon, is necessary, ensure that terms are defined. Jargon is here considered to include word-coded items and "AN" nomenclatured items. Consider the incorporation of a glossary if jargon must be used.

3. Respond to each and every requirement statement contained in the applicable (SOR) or (ADO).

4. Elaborate on, expand, or add to the ADO/SOR requirements as required to cover all important development goals. Identify any objects added to the requirements listed in the SOR or ADO.

5. Avoid references to the use of commercial proprietary materials or equipment items unless a useful purpose is served thereby and a brief justification is presented. Considerations of possible premature and unjustified commitments to the acceptance of such items for production procurement are involved at various levels of TDP review and approval.

6. Point up coordinative actions being taken or to be taken to insure:
   (1) maximum utilization of development knowledge and end products achieved in other developments and
   (2) dissemination of information to groups outside of the present development.

7. Point up actions being taken or to be taken to insure use of existing Fleet know-how in the operation and maintenance of the system to be developed. Include considerations of Fleet use in strategic and tactical operational applica-

tions and where applicable point out how use of the new system will improve these areas.

8. For each of the major sections of each TDP, i.e., technical, managerial, financial, and personnel; list the name, organization, and phone number of responsible contact(s).

9. Avoid references to other documents or to correspondence unless you include a synopsis of or quotation from those portions of the references which make them useful. In important cases, include copies of the correspondence as enclosures.

10. Never refer to past tests associated with the development without indicating broadly the results or stating conclusion(s) reached from the tests.

11. Discuss briefly the feasibility of achieving the development objectives. Identify risk areas and estimate their importance to the achievement of objectives. Cite available alternative developmental approaches in those cases where risks are high and the risk areas are vital to achieving objectives. Alternatively, cite the reduced capabilities (lowered objectives) which may result from a lesser achievement in a vital risk area.

12. Give consideration to including the PTA document basic to some TDPs as an enclosure. The PTA often contains material of importance to the overall project which can be utilized effectively as enclosed reference material.

13. Wherever the TDP is directed to the development of a system which in itself is a component of a still larger system, and where this fact is not already addressed in the basic requirements documentation (ADO, SOR), describe the development as being of that nature. Also, consider and describe what, if any, additional requirements are placed upon the present development by virtue of its role in the larger system. An example of such a development would be a detection system which in turn supports subsequent navigation, kill, and possibly other functions of the "larger" system. The TDP for the detection system should supplement the requirement documentation as required to insure that the support requirements to be furnished the larger system are identified and accounted for in development objectives.

14. Describe and give credit to past exploratory research and exploratory development activity, which indicate that the present development is feasible. Where the origin of a concept for system developments can be clearly established identify such origins. Use of personal names and the names of commercial concerns should be avoided for various reasons, including legal.

15. Consider the implications of patent ownership to the Navy's production and application of the system under development. Point up decisions made in the past or to be made in the future which depend upon such patent ownership and reflect importantly either on the direction and execution of the development or later production and use.

16. Do not predict or anticipate the future award of a contract to a specified company or to any among a plurality of specified companies unless it is unavoidable to do so and justification is presented.

17. Consider and, if applicable, describe any friendly foreign government interests in the development which could be of importance to review and approval authorities.

18. Consider and, if applicable, describe any U.S. Army or U.S. Air Force interests in, participation in, or potential future applications of the development.

19. In cases where TDPs contain proprietary information which is known to be or may be reasonably presumed to be a matter of commercial rights or ownership, the fact that such information is contained therein should be prominently indicated on the outer cover. The location(s) of occurrence of such information should also be indicated in the text.

20. An approved TDP comprises a bilateral agreement between the principal development activity and higher authorities. Any changes to the development plans, which affect technical objectives, funds, or schedules should be documented by the parties at the time of occurrence and reported by the development activity in TDPs at the time of next revision.

21. The bilateral agreement nature of an approved TDP affords a stabilizing influence on the planning and execution of developments insofar as the descriptive material in the plan permits a mutually understood and recognized development to be established. Give consideration to this fact in establishing the content of TDPs. See that important matters which can affect the development, but which are subject to controversy or opinion, or which are otherwise of such a nature as to be likely to change without considered and valid reason, are defined and agreed upon at the start.

22. Anticipate the scope and content of TECHEVAL and OPEVAL tests. Consider the bearing such tests have not only on the development in terms of development objectives which must be established and met, but also in terms of describing any special laboratory or Fleet capabilities which will be required to evaluate the system.

23. Ensure that problems, difficulties, obstacles, troubles, etc., are discussed sufficiently to ensure that they are not indicated as insurmountable barriers, unless such is the case, in which event be very explicit in stating the facts. Review authorities will be keen to know your estimate of the overall importance of such items in meeting objectives and what is being done by whom to solve, by-pass, or otherwise overcome or "live with" them.

24. If future action by review authorities outside of the NMSE is recommended or expected, be clear in saying so, referring to the item in covering correspondence such as the forwarding letter in those cases where such items are first announced in the TDP.

25. Make known the professional competence of the development team. Examples usually exist among in-house personnel or organizational units, laboratories, committees, consultants, commercial activities, and personnel or units of the Fleet or other non-NMSE activities, including those of other military services. Do not assume that competence, which may often be of a unique nature, e.g., past successful experience in a field having no industrial counterpart, is already apparent to reviewers.

26. Describe the ways and means which are being exploited to inject original thinking, new ideas, alternative concepts, and the latest technology into the development.

27. Avoid ambiguous words and phrases, especially those having a concerted local use and meaning which may not be clearly understood elsewhere. Some potential examples culled from TDPs are:

advanced,	quantum jump,
integrated,	identify,
concurrency,	classify,
breakthrough,	electronic.

28. Clearly show in milestone charts, in the text of SECTION 4, and elsewhere, as appropriate, what action constitutes the end of the project. This is especially important in cases where the TDP is in response to an ADO and studies or experiments to determine feasibility, financial acceptability, etc., are involved. In such cases, a formal report of findings and recommendations for possible further development action often satisfies the end requirements of the ADO and this fact should be made clear in the TDP. Plans extending beyond such a terminal point (e.g., plans showing issuance of an SOR followed by engineering development, service tests, etc.) should be clearly identified as being interim proposals subject to future approval and subject to change when final results are in hand.

29. Consider industrial participation, interest in, and application of the development in whole or in part as applicable. Where past, present, or future industry-sponsored research and development will be capitalized upon with attendant advantages in time, costs, planning, etc., identify such areas and advantages. Show where, for example, cost sharing contracts will be sought.

U.S. GOVERNMENT PRINTING OFFICE 1967 O—261-122

UNCLASSIFIED

Security Classification

DOCUMENT CONTROL DATA - R & D

Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1. ORIGINATING ACTIVITY (Corporate author)
Headquarters Naval Material Command
(MAT 0325) Washington, D.C. 20360

2a. REPORT SECURITY CLASSIFICATION
UNCLASSIFIED

2b. GROUP
--

3. REPORT TITLE
GUIDE FOR THE PREPARATION OF TECHNICAL DEVELOPMENT PLANS

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)
--

5. AUTHOR(S) (First name, middle initial, last name)
--

6. REPORT DATE
July 1965

7a. TOTAL NO. OF PAGES
106

7b. NO. OF REFS
--

8a. CONTRACT OR GRANT NO
--

b. PROJECT NO
--

c.

d.

9a. ORIGINATOR'S REPORT NUMBER(S)
NAVMAT P3910

9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report) (SUPDOCS, GPO price $1.75)
Navy Stock No. 0518-391-0000

10. DISTRIBUTION STATEMENT
THIS DOCUMENT HAS BEEN APPROVED
FOR PUBLIC RELEASE AND SALE;
ITS DISTRIBUTION IS UNLIMITED

11. SUPPLEMENTARY NOTES
Companion document to NAVMAT P3910-A
"Guide for the Preparation of Proposed
Technical Approaches (PTA)"

12. SPONSORING MILITARY ACTIVITY
Headquarters Naval Material Command
(MAT 0325) Washington, D.C. 20360

13. ABSTRACT

This document provides guidelines for the preparation of Technical Development Plans (TDPs) to assist Principal Development Activities within the Naval Material Command. Its objective is to provide guidance for the evolution of comprehensive planning sufficiently standardized to provide R&D managers with sound decision information.

The TDP itself is THE plan for the guidance and conduct of the RDT&E phases of systems. It presents an outline of the needs of higher echelon R&D managers to properly evaluate the technical, managerial, financial, and personnel plans for the system development, and all available information on procurement and production.

DD FORM 1473 (PAGE 1)

UNCLASSIFIED

Security Classification